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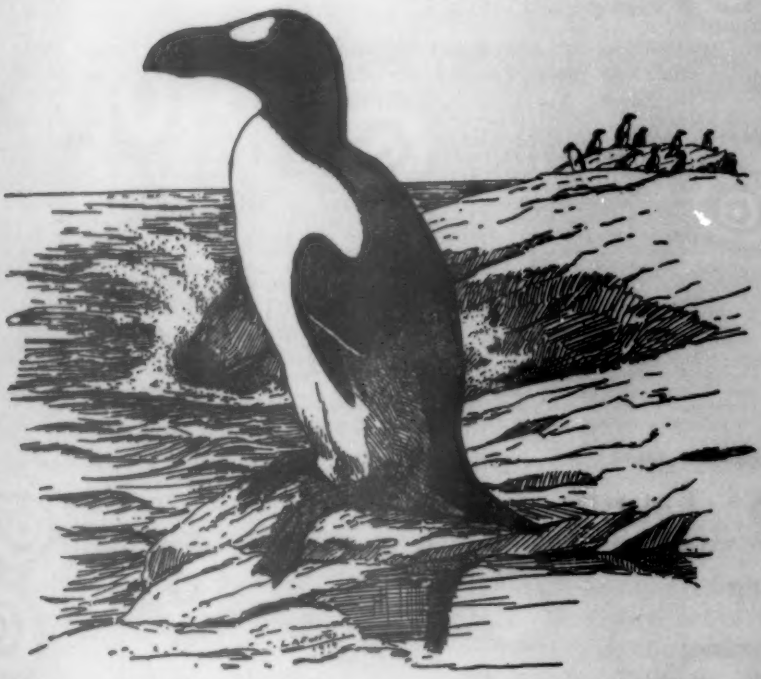

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EFFECT OF TEMPERATURE AND SEASON ON ENERGY RESOURCES OF THE ENGLISH SPARROW

BY S. CHARLES KENDEIGH

INTRODUCTION

IN order better to understand the underlying causes regulating the distribution, migration, abundance, reproduction, and other aspects of bird behavior, a series of researches has been undertaken to determine the manner in which the energy balance of the bird is affected by environmental factors. An early study (Kendeigh, 1934) outlined the problem and some of the environmental factors that are involved. A relation of size and number of eggs per set to temperature and energy resources was demonstrated in 1941. In 1944, the rate of energy outgo for standard metabolism was shown to vary inversely with temperature as a straight line between + 37° and − 40° C. In 1945, measurement was made, over the same wide range of temperature, of the extent and ability of birds to utilize the energy reserve in their bodies for postponing death from starvation.

The present study is concerned with measurement of the rate of energy intake at these same temperatures and an analysis of the energy resources of the bird throughout the year. There have been many detailed studies of the energy values of different kinds and amounts of food for chickens and other domestic animals and on the energy resources of these animals (Brody, 1945). Only an occasional study, however, treats of the influence of temperature on the utilization of food energy (Kleiber and Dougherty, 1934). Larguier des Bancels in 1902 and Lapicque and Lapicque in two papers in 1909 demonstrated in a few species of wild birds a decrease in gross energy intake with a rise in temperature. There are other references scattered in the literature on the weight consumption of food at different temperatures (especially Rörig, 1905: 24–34). Most of the work on the

food of wild birds has dealt with the identification of the items consumed.

Dr. Tom S. Hamilton, Department of Animal Science, University of Illinois, kindly had made in his laboratory for the present study the caloric determinations of bird food and excrement and also read and commented on the manuscript.

PROCEDURE

English sparrows, *Passer domesticus*, were placed consecutively at different temperatures under controlled laboratory conditions for a total of several weeks. The birds were captured and all experiments run between the middle of November and early in March to represent the birds in the winter phase of the yearly cycle. The responses of birds during the summer period, when breeding and molt are in process, would likely be quite different.

The food supplied the birds was the University of Illinois chick mash No. 393 containing the following ingredients: 49 parts ground corn, 10 parts ground oats, 15 parts bran, 10 parts middlings, 5 parts alfalfa meal, 5 parts meat scraps, 5 parts soy bean oil meal, and 1 part salt. This mixture contained 15 per cent protein, a moisture content of 13 per cent, and an energy value of 4.40 large calories per gram of dry weight. The diet contained all known essential food elements; the birds consumed it readily and appeared to do well on it. Caloric determinations of unused food remaining in the dishes at the end of experimental periods were not significantly different from those of fresh food, indicating that the birds did not discriminate appreciably in their selection of food from the mixed diet available to them.

Weighed amounts of food were given the birds at intervals of three or four days. The food was offered in a fresh condition without drying, although the dry weight was calculated. At the end of a feeding period, the food tray was removed, excrement separated, and the food dried at 100° C. to determine the *gross energy* consumed. All weights were measured to one-tenth gram.

The excreta were separated by hand from the unused food, dried at 100° C., and their caloric value determined. This caloric wastage subtracted from the gross energy gives the *metabolizable energy* of the food consumed (= available energy of Kleiber and Daugherty, 1934: 713). No correction could be made for the slight loss of energy due to fermentation of undigested food and energy utilization by bacteria in the large intestine.

The birds were confined in small cages of hardware cloth, measuring 5 by 10 by 10.5 inches, with the greatest dimension being the height.

The small size of the cages prevented much activity. These cages were closely fitted into metal trays having a depth of four inches. Single sheets of newspapers were also placed in the trays to catch grain particles tossed or kicked out by the birds. Water was supplied at temperatures above freezing, and snow or frost was taken from the refrigeration plates at lower temperatures.

Various degrees of temperature were maintained through use of a special constant-temperature unit for extreme temperatures and constant-temperature rooms for the medium temperatures. The photoperiod was maintained at 10 hours of light per day in all experiments by means of two 100-watt light bulbs connected with an automatic time switch which turned the lights on at 7:00 a. m. and off at 5:00 p. m., Central Standard Time. The birds were in absolute darkness when the artificial lights were off, and there was no feeding during these hours.

Preliminary experiments were performed during the winter of 1944–45 and 61 experiments during the winter of 1945–46. Some experiments were unsuccessful due to mortality, intrusion of mice, or other difficulties so that 54 successful measurements of food absorption were obtained at various temperatures on five male and nine female birds. The total number of days of feeding by individual birds involved in getting these measurements is 850. The same bird was used at all temperatures as far as possible, so that individual differences in food absorption at the various temperatures were largely eliminated. Because careful attention showed there were no sexual differences in food absorption or excrement eliminated, all data are combined as of equal value. The number of records obtained at extremely low temperatures was few, as the birds had to be acclimated step by step or mortality resulted.

Each bird was kept at each temperature level until successive measurements over three- or four-day intervals gave similar results in amount of food consumed and in maintenance of weight. In this way it was certain that the birds had become adjusted to the temperature, were feeding and behaving normally, and had established an existence level or balance of energy ingo and outgo. Data obtained before this balance was reached were not used. The average daily change in weight was $\pm$ 0.07 gram. This variation is so small that it may be accounted for by the amount of food and unvoided excrement that happened to be in the bird at the time of its weighing.

ENERGY INTAKE

From Table 1 it is apparent that the amount of food ingested,

TABLE 1

EXPERIMENTAL DATA ON FOOD CONSUMPTION BY ENGLISH SPARROWS

Temperature (°C.)	Number of birds	Total days feeding	Average weight of birds (grams)	Average weight change per day (grams)	Food intake		Excrement loss			Metabolizable energy	
					Cal. per bird per day	Standard deviation	Cal. per bird per day	Standard deviation	Percent of food intake	Cal. per bird per day	Standard deviation
−31	3	24	24.3	−0.03	39.60	±0.44	6.41	±0.59	16.2	33.19	±0.50
−25	3	36	24.2	+0.07	35.20	0.27	5.79	0.26	16.4	29.41	0.91
−13	6	100	24.7	−0.06	31.24	0.84	4.96	0.19	15.9	26.28	0.89
−4	6	81	23.1	+0.18	26.40	3.11	3.77	0.26	14.3	22.63	2.58
+10	12	208	24.3	+0.06	25.96	3.74	3.26	1.32	12.6	22.70	3.07
+24	12	194	23.1	−0.02	18.04	1.87	2.01	0.07	11.1	16.03	1.64
+34	12	207	22.9	−0.10	16.28	2.68	1.90	0.59	11.7	14.38	2.34

gross energy, increased with a drop in air temperature. Figure 1 shows that this increase was a linear one. As Kleiber and Daugherty (1934: 709–711) found with baby chicks, there appears to be no limit to the birds' appetite with decreasing temperatures.

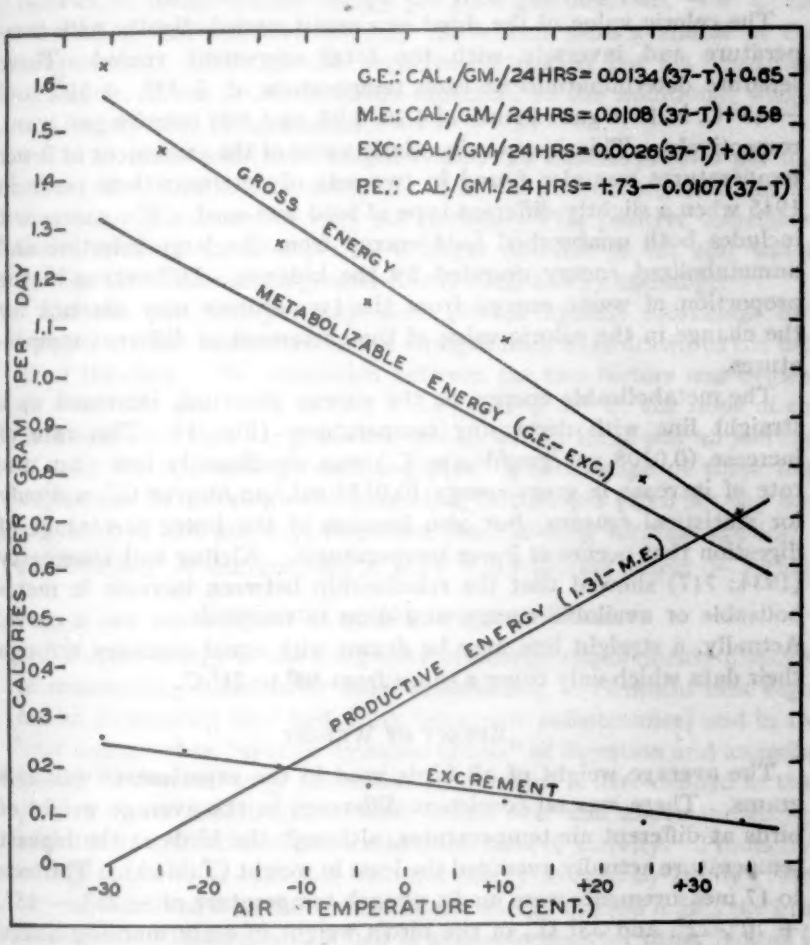

FIGURE 1. Energy intake of English sparrows at various temperatures.

The amount of energy lost in the excrement also increased with decreasing temperatures (Fig. 1). This would be expected from the larger amount of food ingested and from the increased rate of metabolism in the body generally. In addition, the percentage of energy intake that was lost in the excrement varied from 11.1 at 24° C. to

16.4 at − 25° C. (Table 1), which indicated a less efficient digestion and a less complete utilization of food energy at the lower temperatures. It is well known for other animals that the completeness of digestion and absorption decreases as the mass of food ingested increases (Brody, 1945: 79–86).

The caloric value of the dried excrement varied slightly with temperature and inversely with the total excrement voided. Three separate determinations at each temperature of + 33°, + 10°, and − 15° C. in 1946 gave figures of 4.20, 3.98, and 3.87 calories per gram, respectively. This decrease in caloric value of the excrement at lower temperatures was also found in two sets of determinations made in 1945 when a slightly different type of food was used. The excrement includes both unabsorbed food energy from the large intestine and unmetabolized energy excreted by the kidneys. Differences in the proportion of waste energy from the two sources may account for the change in the caloric value of the excrement at different temperatures.

The metabolizable energy, or the energy absorbed, increased as a straight line with decreasing temperatures (Fig. 1). This rate of increase (0.0108 cal./gm./degree C.) was significantly less than the rate of increase in gross energy (0.0134 cal./gm./degree C.), not only for statistical reasons, but also because of the lower percentage of digestion that occurs at lower temperatures. Kleiber and Daugherty (1934: 717) showed that the relationship between increase in metabolizable or available energy and drop in temperature was a curve. Actually, a straight line may be drawn with equal accuracy through their data which only cover a range from 40° to 21° C.

Effect of Weight

The average weight of all birds used in the experiments was 23.8 grams. There was no consistent difference in the average weight of birds at different air temperatures, although the birds at the highest temperature actually averaged the least in weight (Table 1). Thirteen to 17 measurements were made, at each temperature of − 25°, − 15°, + 10°, 22°, and 33° C., of the bird's weight in early morning before feeding commenced and in late afternoon after the last feeding had occurred. The average differences in these weights at the above temperatures were 1.76, 1.76, 1.08, 1.40, and 1.30 grams, respectively. Except for the low value of 1.08 grams at + 10° C., there was evident a greater daily rhythm in weight correlated with the greater energy exchanges at lower temperatures. The food assimilation during the daylight period was sufficient to offset the energy requirements for the

entire 24 hours so that the average weight was maintained fairly constant throughout the experimental period.

Coefficients of correlation at − 13°, + 10°, 24°, and 34° C. gave an average of − 0.39 ± 0.26 between weights of individual birds and calories of metabolizable energy *per gram* per day. At − 4° C. the correlation was positive, but only six records were available at this temperature. Although the negative correlation has low statistical reliability, it was in the direction expected, as the additional weight was largely inert fat and water.

The correlation between weight of bird and calories *per bird* per day averaged + 0.46 ± 0.20, except at − 13° C. where a negative correlation was again based on only six records. This positive correlation indicated that, in addition to a larger amount of fat and water, heavier birds have also a greater rate of total energy exchange.

Calories per bird per day were plotted against individual bird weights at each temperature, and straight lines were drawn to the best fit of the data. No correlation between the two factors was evident at − 13° C. At − 4°, + 10°, + 24°, and + 34° C. the slope of the lines indicated that per gram increase in weight there was an increase of 1.2, 0.5, 0.6, and 0.6 cal./bird/day. The average of these four values was 0.7 calories. In converting calories per gram per day into calories per bird per day, therefore, the following formula applies:

cal./bird/day = cal./gm./day × [23.8 + 0.7 (grams weight − 23.8)].

EXISTENCE AND PRODUCTIVE ENERGY

Existence energy is the composite of energy requirements involved in maintaining standard or basal metabolism, in chemical heat regulation, in securing food and drink (economic maintenance) and in the heat increment or "specific dynamic action" of digestion and assimilation. *Productive energy* (economic production) is here defined as that portion of the metabolizable food intake over and above the energy requirements of existence at a minimum level of activity. Productive energy is not to be confused with net energy as used by Brody (1945: 34) who defined it as the metabolizable energy of food minus the heat increment of feeding, and which is available both for other factors in existence metabolism and for productive activities. It agrees, however, with net energy as used by Kleiber and Daugherty (1934: 703–704). Productive energy is of importance to the bird as this is the energy utilized for such activities as growth, locomotion, migration, reproduction, molt, and fat deposition.

In the present experiments, the birds maintained a constant weight that averaged about 5.4 grams less than they maintain under free

natural conditions out-of-doors (Baldwin and Kendeigh, 1938: 436–437). The exact reasons for the decrease in weight of birds brought indoors are not known but are doubtless related to close confinement in inside cages. The birds were free to move around in their small cages, but frequent observations indicated that movements were confined for the most part to those associated with feeding. Since no obvious work was performed except that of existence and since existence was held at a weight level just above that of starvation (Kendeigh, 1945: 220), it appeared that there was no appreciable productive energy involved and that the metabolizable energy in these experiments was equivalent to existence energy.

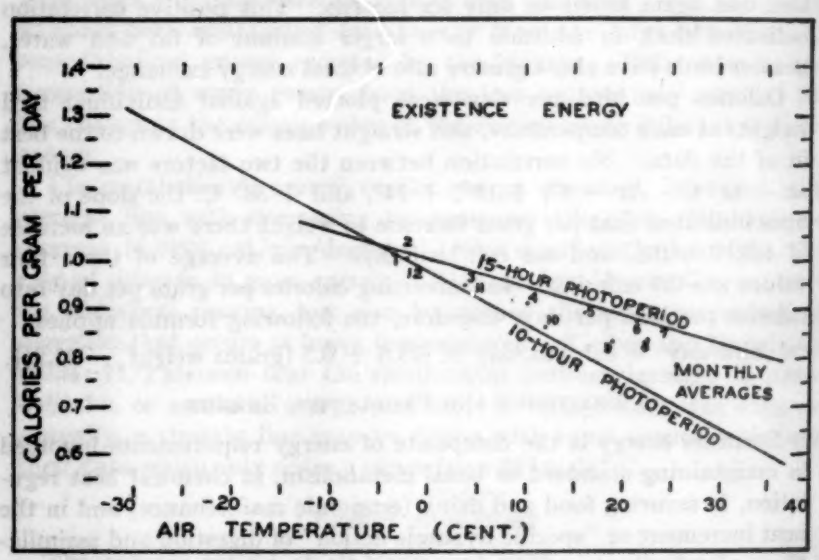

FIGURE 2. Energy requirements for existence of English sparrows at two photoperiods with monthly averages for Champaign, Illinois. Data for the 15-hour photoperiod are from Seibert (1949: 134).

It would be useful to know the maximum rate of food absorption of which the bird is capable. Under the stimulus of low air temperatures, existence energy at − 31° C. becomes 114 per cent greater than at + 34° C. However, at temperatures below − 20° C., as mentioned above, a readjustment or acclimation of the energy balance appears necessary. At these extreme low temperatures, the rate of energy intake may be approaching, if not actually reaching, a maximum in the vicinity of 1.31 cal./gm./day. If this "maximum" energy intake could also be attained at higher temperatures, when demands for

purposes other than heat production required it, the productive energy would be the difference between the potential energy intake (1.31 cal./gm./day) and the energy required for existence (Fig. 1).

A factor, other than temperature, that is very important in affecting the energy resources of birds is the daily photoperiod (Fig. 2). Seibert (1949) has measured the energy intake for existence of English sparrows in a photoperiod of 15 hours of light per day. Comparisons can be made with the energy intake under the 10-hour photoperiod here reported. Energy utilization in terms of calories per gram per day generally was found to be greater under a 15-hour than a 10-hour photoperiod, but as temperatures dropped the difference between the two photoperiods diminished until it disappeared altogether below − 5° C. Since birds have a higher rate of standard metabolism during the wakeful, light period and since they are also more active during the daylight period when they do all their feeding, a greater energy utilization during the long photoperiods would be expected.

SEASONAL CHANGES

Knowing the effect of air temperature and photoperiod upon the energy balance, it is possible to calculate what changes may occur in this balance from month to month under natural conditions out-of-doors (Table 2). Using the mean monthly temperature and photoperiod at Champaign, Illinois, corresponding calories per gram per day were interpolated in Figure 2. In order to use the formula above for converting these values to calories per bird per day, the average monthly weights of adult English sparrows living freely out-of-doors were taken from Figure 3, using the mean temperature of each month as the reference point. In this figure, the curve showing the relation between the average daily weight and air temperature is based on a similar curve given in Baldwin and Kendeigh (1938: 455) and on additional data obtained since that paper was published. Separate curves are given for young and adult birds since young birds, hatched during the summer, do not reach the weight of adult birds until autumn or winter. There are only scattered weights for adult birds during the warmer months, so the curve for adult birds is in part calculated from average differences between weights of adults and young during the summer season. Adult males tend to weigh slightly more than adult females during the autumn and winter, but this difference disappears during the breeding season, and the curve given is an average for the two sexes. It was necessary to determine monthly bird weights in this manner because a sufficient number of actual bird weights have not been taken during all months. Where

comparison was possible, calculated monthly weights agreed closely with weights of adult birds actually measured. The existence energy of adult birds was thus calculated and plotted for each month of the year (Fig. 4).

TABLE 2

VARIATIONS IN MONTHLY ENVIRONMENTAL CONDITIONS AND ENERGY BALANCE OF ENGLISH SPARROWS AT CHAMPAIGN, ILLINOIS

Month	*Mean temperature (°C.)*	*Mean photoperiod (hours, minutes)*	*Actual bird weight, grams*	*Effective bird weight,*[1] *grams*	*Existence energy Cal./gm./day*	*Existence energy Cal./bird/day*	*Cal./bird/day Potential energy*	*Cal./bird/day Productive energy*
January	−3.0	9 44	29.0	27.4	1.007	27.59	35.89	8.30
February	−2.0	10 41	28.9	27.4	1.002	27.45	35.89	8.44
March	+4.0	11 56	28.3	27.0	0.950	25.65	35.37	9.72
April	10.3	13 15	27.7	26.5	0.912	24.17	34.72	10.55
May	16.3	14 20	27.3	26.3	0.893	23.49	34.45	10.96
June	21.6	14 54	27.2	26.2	0.876	22.95	34.32	11.37
July	24.1	14 40	27.1	26.1	0.853	22.26	34.19	11.93
August	22.8	13 43	27.2	26.2	0.832	21.80	34.32	12.52
September	19.0	12 27	27.2	26.2	0.832	21.80	34.32	12.52
October	12.2	11 10	27.5	26.4	0.867	22.89	34.58	11.69
November	4.8	10 2	28.2	26.9	0.928	24.96	35.24	10.28
December	−0.9	9 27	28.8	27.3	0.982	26.81	35.76	8.95

[1] Effective bird weight = 0.7 (actual weight − 23.8) + 23.8 (see p. 119)

To calculate the maximum potential energy intake of birds each month, the value of 1.31 was substituted in the above formula for calories per gram per day. It remains to be demonstrated experimentally, however, that birds are capable of the same potential energy intake during the summer as under the stimulus of extreme cold in winter. The productive energy each month is simply the difference between the potential intake and the amount required for existence.

The curves of existence energy and productive energy are inverse to each other, and the potential energy intake is lower in summer than in winter, when calculated on the basis of lower summer weights of the birds (Fig. 4). Energy for existence is greatest in January when 77 per cent of the potential intake is used for this purpose. During August and September, temperatures are high and the photoperiod has shortened appreciably; thus, the energy cost of existence is at its lowest for the year. At this time it equals 64 per cent of the potential rate of energy intake. Energy requirements for existence increase more rapidly in the autumn than they decrease in the spring, since temperatures fall rapidly and the greater economy of energy during short, compared to long, photoperiods becomes lost. The difference between the minimum summer existence requirements and the winter

maximum is 5.79 cal./bird/day. This may represent the approximate increase of energy required for the bird's tolerance of mid-winter cold.

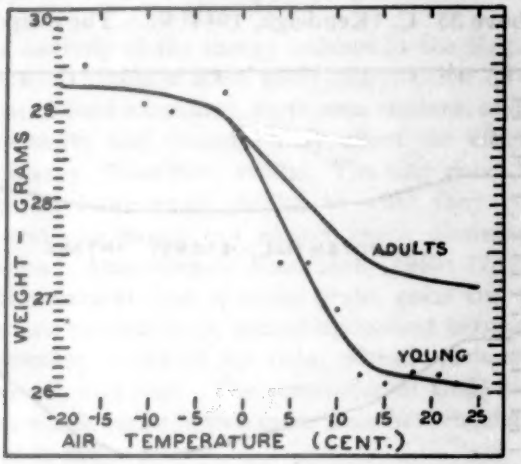

FIGURE 3. Correlation of variations in weight with temperature in English sparrows.

During the mid-winter month of January, the productive energy is 8.30 calories. Minimum existence requirements were determined in these experiments with the birds in small cages where they were hampered in movement and where food was abundantly available for the taking. Under free existence out-of-doors, food must be searched for, and this is often difficult during the winter. Furthermore, the birds seek out roosts at night, must be ever alert for enemies, and have social contacts with one another in flocks, all of which require energy and are involved in maintaining free existence. A surplus of energy is a safeguard also against the demands of short periods of extreme cold when temperatures fall far below the monthly mean. It may well be that the largest part of this productive energy during the winter is used up by the energy cost of living a free existence out-of-doors.

Productive energy increases from the mid-winter low of 8.30 in January to a maximum in August and September of 12.52 cal./bird/day, providing certain modifying factors balance each other. During the summer, food is abundant and easy to find, and it would seem that the energy cost of a free existence would be less. However, by summer the bird's plumage has become worn and thin and it is known that at comparable air temperatures the bird's resting metabolism is higher than during the winter (Kendeigh, 1934: 331–336). Although during

the summer the bird is not subject to the energy drain of severe cold, it is occasionally exposed to excessive heat. Protection is afforded by the evaporation of moisture from the respiratory system, which begins to increase noticeably at temperatures above 25° C. and becomes excessive above 35° C. (Kendeigh, 1944: 9). The evaporation of this

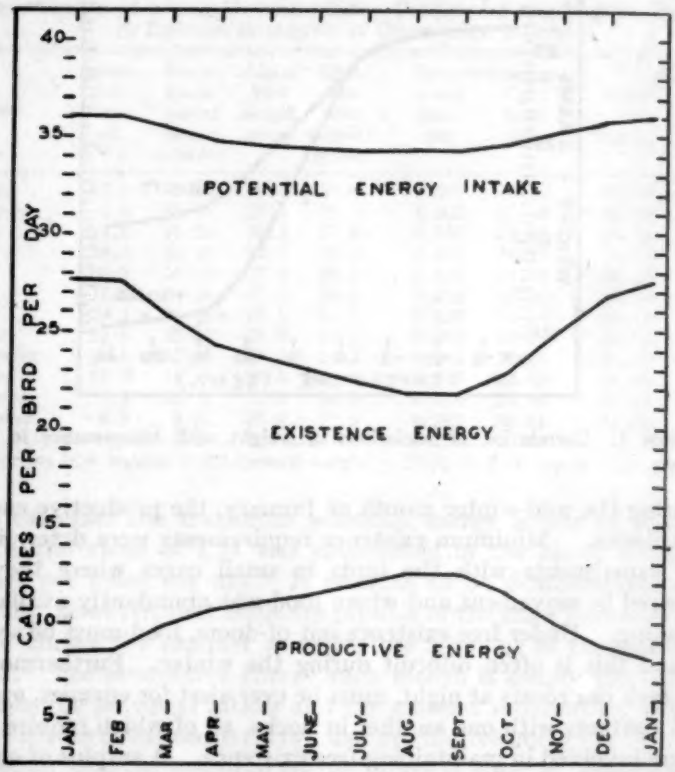

FIGURE 4. Variations in the energy balance of English sparrows throughout the year.

water utilizes energy from the bird, and this, together with the higher resting metabolism, may balance the greater ease in procuring food and shelter. Perhaps the increase of 4.22 cal./bird/day from winter to summer may be considered as the energy available for carrying on reproduction and molt. Nesting activities begin in March and are in full sway in April. During August and September, when potential productive energy is greatest, most birds are through nesting and are undergoing molt and renewal of feathers. All these activities are completed before the curve of productive energy starts to drop

rapidly in the autumn and before the winter regime begins. These theoretical calculations should be checked by actual measurements during each season of the year.

DISCUSSION

The present analysis of the energy balance in the English sparrow is based upon data obtained from their consumption of one kind of diet. The type of food consumed, its protein content, and its balance of essential elements and vitamins may affect the efficiency of its utilization as energy (Hamilton, 1939). The diet given the birds in these experiments, however, is similar to what they get normally out-of-doors, and one would not expect much dissimilarity in its energy utilization. According to Kalmbach (1940: 12, 23–24), 96.6 per cent of their natural food is mixed grain, grass and weed seeds, and fruit, in which cracked corn, picked up around barns and poultry yards, predominates, followed by oats, wheat, various sorghums, barley, buckwheat, and rice. The remainder of their food (3.4 per cent) is insects, which varies from a mere trace in their diet in January to 11.6 per cent in May.

Birds make the most efficient use of their productive energy by the spacing of their major activities so that they do not occur simultaneously or seriously overlap. In the yearly cycle of activities for birds, in general, occur spring migration, competition for territory (male), nest-building, egg-laying (female), incubation (mostly female), feeding of young, molting of feathers, fall migration, and tolerance of winter cold. One activity does not ordinarily begin until the previous one is completed, except that resistance to cold persists to a lessened extent in the spring after nesting begins. Severe weather during the spring will cause delay or a temporary inhibition of nesting activities.

The English sparrow is a permanent resident species, and it is probable that its curve of energy resources is representative of other species of permanent residents as well, although this should be tested. One would expect differences, both in the annual rhythm in energy requirements for existence and in productive energy, in migrant species that leave the region to breed further north or which breed in the region and winter farther south. With some species that go north to nest, Wolfson (1945: 109–121) has found a deposition of fat just before migration begins. At this time, the drain on energy resources for tolerating winter conditions is decreasing, and the energy demands of reproduction have not yet begun; thus, the unused productive energy that accumulates is simply stored in the body. In permanent, resident species, the productive energy is used, as soon as it occurs, in

initiating reproductive activities, and thus there is none available for storage as fat. Spring migration in migrant species may very well wait until this productive energy becomes available and may conceivably be induced by this change in the energy balance. The problem then is why certain species initiate reproductive activities when this productive energy becomes available and other species migrate instead. These different behavior patterns must have evolved over a long period of time in order to furnish each species the best relationship between seasonal physiological and environmental changes.

Seasonal variations in energy exchanges of birds in the tropics should be less pronounced and those in arctic regions more pronounced than those in temperate regions, but acclimatization may have modified their adjustments in various ways. Climatic factors other than temperature and photoperiod, especially rainfall which would affect the food supply, may modify the seasonal rhythm. Doubtless there are also taxonomic differences, as each species may work out its own adjustments based on its peculiar physiological potentialities.

CONCLUSIONS

1. Gross energy intake and metabolizable energy intake of English sparrows, on a voluntary diet just sufficient to give continual maintenance of weight in a photoperiod of 10 hours of light per day, increase as straight lines between + 34° and − 31° C.

2. The increase in rate of metabolizable energy intake (0.0108 cal./gm./degree C.) with decreasing temperature does not keep pace with the increase in gross energy intake (0.0134 cal./gm./degree C.). This is due in part to an increasing percentage of energy loss in the excrement from the large intestine and kidneys.

3. Preliminary calculations indicate that birds during midwinter, living at liberty under natural conditions, have a potential, metabolizable energy intake of 35.89 cal./bird/day, of which 21.80 calories are equivalent to the minimum existence requirement under the most favorable summer conditions, 5.79 calories represent the increased energy cost of resistance to the winter cold, and the remainder (8.30 calories) is productive energy which is divided between the cost of maintaining a free existence and other miscellaneous activities.

4. During spring and summer, under free, natural conditions there may be small decrease in the potential energy intake and a larger decrease in energy required for existence. As a consequence, productive energy may rise to 12.52 cal./bird/day, an increase of 4.22 calories

over midwinter. This additional energy makes possible such other activities as migration, reproduction, molt, and fat deposition.

5. The initiation of migration, reproduction, molt, and other activities requiring considerable expenditures of energy may be conditioned by the availability of productive energy over and above that required for existence.

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DIFFERENCES BETWEEN MIGRANT AND NON-MIGRANT BIRDS IN FOOD AND WATER INTAKE AT VARIOUS TEMPERATURES AND PHOTOPERIODS[1]

BY HENRI C. SEIBERT

INTRODUCTION

AN environmental factor in the life of birds that has recently received considerable attention is the photoperiod. Most of the research on the effect of changing light and dark periods has been directed at the reproductive cycle. The evidence now indicates rather definitely that increasing photoperiods cause an enlargement of avian gonads (Bissonnette, 1937; Rowan, 1938). However, birds undergo seasonal rhythms in physiological processes other than the activity of the gonads. Weights vary with the seasons. Molt occurs regularly in late summer or early autumn and, in some species, fat is deposited subcutaneously in the spring prior to migration. The regularity of these events presupposes that some seasonal environmental condition, occurring with but little variation year after year, must be responsible. The only known factor that meets this requirement is the length of day, that varies with the precision of the earth's revolution around the sun.

A common requirement for the outward manifestations of seasonal rhythms is energy. Recrudescence of the gonads, especially in the female, requires energy, as does molt and deposition of fat; the results of these activities are reflected in seasonal changes of weight. For practically all birds, except owls, feeding or energy consumption occurs only during the daylight hours, when enough must be ingested to furnish the bird with energy for the night. It, therefore, becomes logical to investigate the rôle that the photoperiod plays on the amount of food consumed. Since the energy balance of the body is affected by the temperature to which it is subjected, it becomes necessary to combine external temperature with photoperiod. By obtaining quantitative data on the energy intake under these two sets of variable conditions a better basis will be available for understanding the seasonal changes occurring in birds. Knowing under what conditions the bird is able to gain, lose, or merely maintain itself in its energy balance should supply a clue as to why certain rhythms in behavior occur when they do.

[1]Contribution from the Department of Zoology and Physiology, University of Illinois, Urbana, Illinois.

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REVIEW OF PREVIOUS STUDIES

If an energy balance is maintained, then energy intake must equal energy outgo, and factors affecting one would also affect the other. Although the heat production has been determined for many species of birds, very little research has been done on food consumption in terms of energy intake. Most of the latter has been concentrated on economic species such as the domestic fowl. The effect of photoperiod has scarcely been investigated.

Rörig (1905: 24–34) made an intensive investigation of food consumption of small wild birds and, although he amassed a wealth of data, the caloric value of the food was not determined. In many cases he grouped several species and calculated the amount of food eaten by the entire ensemble. One group of five species of tits and kinglets (three *Parus palustris*, three *P. caudatus*, one *P. coeruleus*, one *P. ater*, one *Regulus cristatus*), totalling 89 grams in weight, ate 18 per cent of their weight per day in dry food, and another group ate 26 per cent. Bluebirds, *Sialia sialis* (25 grams), ate 10 to 12 per cent; a blackbird, *Turdus iliacus* (57.5 grams), ate 10.1 per cent; and a starling, *Sturnus vulgaris* (79 grams), ate 8.0 per cent. He concluded that the smaller a bird was, the relatively more food it consumed. During the summer the amount of food consumed increased, the starling from 8.0 per cent of body weight in winter to 11.9 per cent in summer, *Sylvia cinerea* from 13.4 to 19.2 per cent, the bluebird from 12.4 to 17.7 per cent. This increase was attributed to longer days for food-energy ingestion and shorter nights for energy outgo.

Lapicque and Lapicque (1909 a, b) noted that food consumption decreased as the temperature rose. A change from 13° to 28° C. decreased the grams of food eaten per day from 26.0 to 16.0 in the pigeon, from 11.7 to 6.8 in a dove, and from 13.8 to 6.7 in *Geopelia*. An increase in temperature from 16° to 31° caused the bengali, *Uraeginthus bengalus*, to decrease consumption from 6.10 to 2.98 grams. These writers concluded that the latter bird would die from lack of food in the periods of short daylight of the northern winters, although no experimental proof was given. In a later paper, Lapicque (1911) claimed that the weaver, *Estrelda astrild*, died at 15° C. for lack of food but that light for two to three hours during the middle of the

night enabled it to live at 14° and even 13° C. The precise sensitivity of the bird to such a slight change in temperature is difficult to believe.

Schildmacher (1929) compared the food consumption of two species of weavers, *Ploceus cucullatus abyssinicus* (40 grams) and *Quelea quelea* (18 grams). At 18° C., the former ate 20 per cent of its body weight in food in 24 hours, and the latter 28 per cent. At 7°, the respective percentages were 28 and 33. The ratio of 20 to 28 per cent is 1 to 1.4 and that of 28 to 33 per cent, 1 to 1.18. In other words, the smaller bird did not eat as correspondingly increased amounts of food at the lower temperatures as did the larger. Schildmacher assumed this to indicate that *Ploceus* was better adapted to a lower temperature than *Quelea*. Such low temperatures are not met with in the latter's range.

Although turkey hens were stimulated earlier to sexual activity by the addition of white and red light than by blue, the food consumption was not similarly correlated. Under white light, they ate 69.85 pounds per bird per four weeks; under red, 59.74; under blue, 62.41; and with no additional light, 63.00 (Scott and Payne, 1937: 95). Total food consumption by turkeys was not increased by the addition of artificial lighting, nor was there any difference between birds in heated and non-heated pens, according to Wilcke (1939). However, birds in heated pens ate a considerably higher proportion of mash and much less grain than non-heated birds. Heywang (1945) found no increase in food consumption by pullets as a result of an increased artificial illumination. Beck (1930: 308–330) noted that chickens ate less food in semi-darkness and under green and blue lights.

METHODS

All birds in the experiments here reported were captured by sparrow traps from wild populations. The species used were English sparrow, *Passer domesticus*, slate-colored junco, *Junco hyemalis*, white-throated sparrow, *Zonotrichia albicollis*, blue jay, *Cyanocitta cristata*, and field sparrow, *Spizella pusilla*.

Each experiment started with three to five birds of one species. The individual birds were placed in cages, 10 by 10.5 by 5 inches, made of one-half inch mesh hardware cloth. The cages sat in tall, close-fitting, metal pans, and between the two there was inserted a doubled full-size sheet of newspaper to catch any feed that might escape the pan.

The time of year that these experiments were run was as follows: junco and English sparrow at 34° and 22° C., February 15 to June 13; junco at 10° and −13° C., July 3 to September 15; English spar-

row at −13° C., January 30 to March 30; white-throated sparrow at all temperatures, October 15 to December 12.

Experiments at 22° C. were run in basement rooms, well insulated from the out-of-doors, and fluctuations in temperature between night and day and summer and winter did not vary more than plus or minus two degrees. Experiments at higher temperatures were run in a constant temperature room and those at low temperatures were conducted in a refrigerator unit where the temperature control was accurate to 1° C. The door of the refrigerator was constructed of six panes of glass for insulation and to allow light to enter from the outside. Air temperatures were recorded by self-recording potentiometers using thermocouples. The accuracy of these instruments was checked every other week with thermometers in the temperature units. All the rooms were light-proof and each was illuminated by two 150-watt bulbs regulated by time clocks.

The feed used was a ground mixed chicken mash, the same as that used by Kendeigh (1949: 114), with a caloric value of 4.40 large calories per gram dry weight. This picture does not correspond precisely to the diet that wild birds of these species normally eat. It agrees best with what the English sparrow consumes (Kendeigh, 1949: 114). Experimental conditions make it necessary that the food be measured accurately and easily handled; it should not vary except for the occasional addition of cuttlefish bone and grit. It is doubtful that wild birds could obtain out of doors a more nutritious diet in terms of calories per gram.

A weighed amount of the food was placed in a glass bowl and put into the cage. The moisture content of the feed was determined to be 13 per cent, and this correction was applied to the weighed amount of feed originally given the bird. Water was made available in cups suspended from the side of the cage. After four to five days, the unused food was collected, the feces extracted, and both dried in an oven at 98° C. for over 48 hours and then weighed. The difference in dry weights was, therefore, the amount of food consumed for the period of observation.

The caloric value of the feed and of the feces was determined in a Parr adiabatic oxygen calorimeter.

From the gross energy consumed was subtracted the caloric value of the feces to give the metabolizable energy. The latter value was then divided by the total hours of light to which the bird had been exposed to give the rate of calories consumed per hour. The rate per day was obtained by multiplying the calories per hour by 10 or 15, depending on the length of the light period.

The birds were weighed each time the food was changed, and an attempt was made to do this at the same time each day to cancel variations in weight due to the daily rhythm. The average weight of the bird during the feeding period was the one used to compute calories per hour per gram of live weight.

The photoperiod was increased one-half hour every other day, alternating between morning and evening, beginning with 10 hours to which the birds were adjusted, until 15 hours were reached. This was maintained until at least four collections of feed had been made. Each collection period lasted four to five days. The photoperiod was then reduced to 10 hours at the same rate and collections made until a nearly constant rate of food consumption was obtained. The entire process extended over three months. However, in case of mortality, new birds when available were substituted directly at the current photoperiod without acclimation. It was soon found that birds adjusted themselves quickly to changes in temperature and day-length, so that the changes in photoperiod were increased to one-half hour every day in later experiments. All the juncos and five of seven white-throats used on the 10-hour photoperiod were among those previously used on the 15–hour photoperiod. Because of the time consumed in performing an experiment at one temperature, a single species was run at three, sometimes four, temperatures concurrently, and with the exception of one junco (at 10° C. and 34° C.) a different set of birds was used at each temperature.

Since activity on the part of the bird increases its energy requirements, care was taken to disturb the birds as little as possible. Because of the small size of the cages, activity was limited and confined mostly to feeding. It is unlikely that the birds fed at night. When the lights were turned off, the rooms were in absolute darkness. The cages were examined numerous times at night with a flashlight, and in no single instance was a bird discovered near its food supply. In a separate experiment, English sparrows that were weighed continuously on their perches during the night remained stationary for the entire period of darkness.

All data on the English sparrow at a 10-hour photoperiod were derived from experiments conducted by Kendeigh (1949).

GROSS ENERGY

Table 1 demonstrates that all three species increased the amount of food consumed as air temperatures dropped. The grams of food consumed per bird have not been incorporated in Table 1 but can be

readily calculated by dividing the caloric intake by 4.4 which is the number of calories per gram of dried feed.

Most data on food consumption by wild birds have been in terms of grams of food eaten in relation to body weight. Rörig's birds, most comparable to the junco in size, ate 18 per cent of their body weight per day during the winter (short day, but indoors at room temperature). Lapicque and Lapicque (1909a) calculated that the bengali, weighing approximately 15 grams, ate 18 per cent of its weight at 31° and 40.7 per cent at 16° C. Our juncos, averaging 19 grams, ate 17.2 per cent at 34° (average of both photoperiods) but only 22.4 per cent at 10° C. In no case was there a doubling in the amount consumed within the short temperature range of Lapicque's experiments. Our values for the larger sparrows at 22° were higher than those given by Rörig for a 25-gram bluebird. However, the sparrows were fed grain which contained more waste material than the dried animal food that was given the bluebird. Taber's results (1928), presumably taken during the summer at out-of-door temperatures, showed that the junco ate 13.5 per cent, the white-throat, 15.8, and the English sparrow, 11.9. In comparison, our birds ate 17.7, 17.6, and 20.2 per cent, respectively. These values are greater than those obtained by Taber, as would be expected from his method of computation which is subject to several errors. He made use of the differential in evening and morning weights of birds to calculate their food consumption. However, the evening weight is not necessarily the maximum weight attained by the bird. The gain in weight measures only the energy stored and not the energy expended in obtaining the food and in other activities. More food must be consumed than is indicated by the gain in weight. Furthermore, the loss in weight measures the amount of feces lost during the night or the amount of food the bird had in its digestive tract before it ceased feeding and metabolic loss of food reserve (fat) in the body, not the total food that passed through the digestive tract during the course of the day.

The hourly rate of food consumption was greater on a 10-hour day than on a 15-hour day. In only two cases, however, (the white-throat at 22° and the English sparrow at − 13° C.) was the increased hourly rate sufficient to enable the bird to eat more on a 10-hour day than on a 15-hour day. Rörig (1905: 29) also found that his birds ate more during the long summer days than during the winter.

Energy Loss in Excrement

The excrement from birds consists of undigested food, digested but unabsorbed food, together with the nitrogenous wastes from the

TABLE 1

EXPERIMENTAL DATA ON ENERGY INTAKE IN BIRDS

Temperature (°C.)	Photoperiod (hours)	Number of birds	Total days feeding	Average weight of bird (grams)	Gross Energy		Energy of Excrement			Metabolizable Energy			
					Cal./bird/day	Cal./bird/hour	Cal./bird/day	Cal./bird/hour	Percent of food intake per day	Cal./bird/day	Cal./bird/hour	Cal./kg./day	Cal./sq. meter/day
							JUNCO						
34	10	4	50	18.6	12.61	1.26	1.96	0.20	15.5	10.64	1.06	599	1569
	15	4	107	18.9	15.77	1.05	2.37	0.16	15.0	13.41	0.89	708	1880
22	10	2	51	18.5	14.92	1.49	1.21	0.12	8.1	13.72	1.37	752	1978
	15	2	62	20.9	15.68	1.05	1.61	0.11	10.3	14.07	0.94	701	1932
10	10	2	36	18.9	18.43	1.84	2.47	0.25	13.4	15.95	1.60	841	2238
	15	5	132	20.0	19.95	1.33	1.92	0.13	9.6	18.04	1.20	940	2532
−13	10	1	18	20.1	25.97	2.60	5.96	0.60	23.2	20.00	2.00	999	2717
	15	2	39	19.7	28.52	1.90	5.36	0.36	18.8	23.18	1.55	1274	3337
							WHITE-THROATED SPARROW						
34	10	3	53	23.7	15.68	1.57	2.08	0.21	13.3	13.61	1.36	579	1663
	15	2	48	19.6	16.08	1.07	2.12	0.14	13.2	13.96	0.93	698	1889
22	10	3	60	27.7	20.68	2.07	2.74	0.27	13.3	17.94	1.79	652	1973
	15	3	54	25.0	19.95	1.33	1.74	0.12	8.7	18.23	1.22	725	2114
−13	10	3	63	22.2	23.47	2.35	4.56	0.46	19.4	18.92	1.89	870	2427
	15	2	19	23.1	29.97	2.00	6.08	0.41	20.3	23.89	1.59	1036	2945
							ENGLISH SPARROW						
34	10	12	207	22.9	16.28	1.63	1.90	0.19	11.7	14.38	1.44	628	1782
	15	2	60	24.1	20.07	1.34	1.59	0.11	7.7	18.45	1.23	787	2278
24	10	12	194	23.1	18.04	1.80	2.01	0.20	11.1	16.03	1.60	695	1978
22	15	3	87	24.1	23.99	1.60	2.16	0.14	9.0	21.83	1.46	902	2595
−13	10	6	100	24.7	31.24	3.12	4.96	0.50	15.9	26.28	2.63	1065	3100
	15	4	51	24.0	31.00	2.07	5.37	0.36	17.3	25.63	1.71	1068	3212
							BLUE JAY						
22	10	1	29	79.0	62.18	6.22	14.70	1.47	23.6	47.48	4.75	601	2580
	15	1	20	80.7	54.10	3.61	14.10	0.94	26.0	40.00	2.67	495	2136
							FIELD SPARROW						
22	15	1	25	10.7	20.72	1.38	1.74	0.12	8.4	18.98	1.26	1775	3905

kidneys. All references to excrement or feces in this paper refer to the products combined.

The total caloric value of the feces excreted divided by the daylight hours to which the birds were exposed was used to derive the calories lost per hour in the feces. Daylight hours instead of the full 24 hours per day were used because this method gives results that are closer to the actual rate and because direct comparisons with the hourly rate of food consumption were desired. Although birds voided excrement at night, the preponderance of defecation at night occurred shortly after the birds had ceased to feed, and the rate declined rapidly thereafter. In the morning when the birds began feeding, the digestive tract was empty, and elimination of feces did not become regular until after feeding was well underway. The loss of feces in the early night and the lack of it in the early morning are approximately equivalent. Daily rates were obtained by multiplying the hourly rate obtained in this manner by the photoperiod to which the bird was exposed.

Decreasing temperatures generally increased the number of calories lost by way of the feces, except at 22° in the junco at both photoperiods and in the white-throat at 22° on the 15-hour day (Table 1). This increase was due largely to the greater amount of food consumed.

It is known from nutritional studies that the greater the quantity of food consumed per unit time, the less relative amount that is digested. The percentage of food intake that is excreted should, therefore, increase with a drop in temperature because of the greater amount of food that is eaten. This was partially true; the highest percentages occurred at − 13° C. (Table 1), but the lowest percentages came as often at 22° as at 34° when the least food was consumed.

Calorimetric determinations of the feces from birds kept at different temperatures indicated a difference with temperature in the energy per dry weight of the feces excreted (Fig. 1). In all species, the caloric value of the feces per unit weight was least at 22°. Either the most efficient absorption occurred at this temperature or the feces contained a different ratio of the wastes from the intestine and kidney. At − 13°, the white-throat and junco had a lower percentage of wastage of consumed food than did the English sparrow. At 34 to 37° C., the wastage of energy in all species was greater than at any other temperature. At 37° C. the junco and white-throat had a greater wastage of energy than at any other temperature investigated. This is presumably true for the English sparrow, although to a less extent, since at 34° C. its wastage was about equal to that at −13° C.

If the voiding of excrement is computed for the same number of

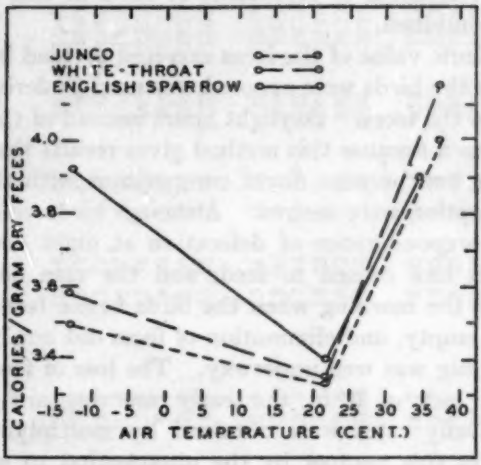

FIGURE 1.—Calories per gram of dry feces excreted by junco, white-throated sparrow and English sparrow on a 12-hour day at various temperatures.

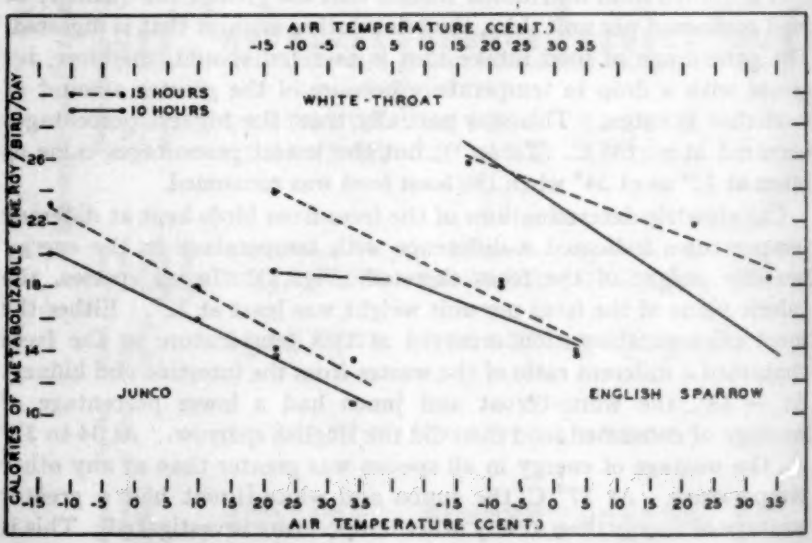

FIGURE 2.—Calories of metabolizable energy absorbed per bird per day by junco, white-throated sparrow and English sparrow on a 15- and 10-hour photoperiod at various temperatures.

hours as feeding took place, all birds at all temperatures excreted more per hour when on the 10-hour than on the 15-hour photoperiod (Table 1). This is what would be expected from the fact that the birds similarly ate more per hour on the shorter photoperiod.

However, in only six of 11 cases were more calories excreted per bird per day during the 15-hour photoperiod, in spite of the greater food consumption. This lack of increase in excrement loss indicates a more leisurely and complete digestion because the caloric food intake per hour was at a slower rate.

METABOLIZABLE ENERGY

Metabolizable energy is the food actually digested and absorbed by the bird. This energy must provide the bird with all its energy requirements for existence and productive activities. The latter would include movement, growth, molt, and reproduction.

Metabolizable energy intake increased with decreasing temperatures (Table 1). In all birds at each temperature the metabolizable energy absorption per hour was greater during the short than the long photoperiod, notwithstanding differences that occurred in the number of calories excreted. No birds, with the exception of the English sparrows at − 13° C. and the blue jay at 22°, were able to absorb as much during the 10 hours as during the 15 hours, in spite of the increased hourly rates of food absorbed during the short day.

Changes in temperature and photoperiod had varied effects on the three species, and these are shown in Figure 2 where the straight lines were fitted to the observed points by the least squares method. The junco responded by increasing its intake of metabolizable energy proportionally to the drop in temperature at both photoperiods, but at a slightly faster rate on the long day. The white-throat increased its intake on the 15-hour day at a slower rate than the junco. However, on the 10-hour day, at some point between 22° and − 13°, it was unable to increase further its intake proportionally with a drop in temperature, with the result that the straight line relationship no longer held. On the other hand, the English sparrow was able to maintain a rapid increase with drop in temperature when the day was 10 hours long but had a slower increase when it was 15 hours. At − 13° C. its energy intake on a 10-hour photoperiod equalled its intake on a 15-hour period. Since existence needs increase proportionally to a decrease in temperature (Kendeigh, 1949), any deviation from this relationship should give an indication of the bird's ability or inability to meet its requirements at that particular temperature.

Since the experimental birds were kept in small cages and left

relatively undisturbed, the need of productive energy was negligible. The energy utilized was presumably directed to existence which involved standard metabolism plus the energy increment of feeding and chemical heat regulation. Any energy intake in excess of these requirements would have been stored and reflected in an increase of weight. If a minimum level of energy intake was not maintained, existence would be possible only as long as reserve fats in the body were available for utilization. Any deviations in a strict balance between energy intake and outgo would be reflected in changes of body weight.

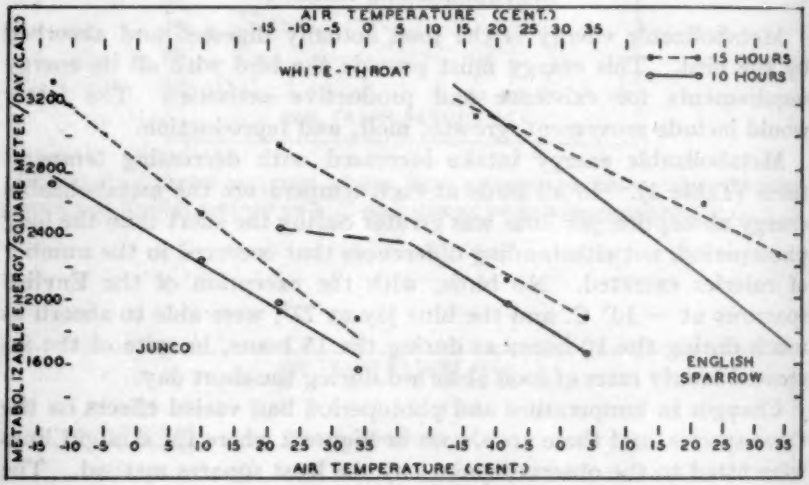

FIGURE 3.—Calories of metabolizable energy absorbed per square meter of surface per day by junco, white-throated sparrow and English sparrow on a 15- and a 10-hour photoperiod at various temperatures.

In a series of body weights determined from recently trapped birds, Baldwin and Kendeigh (1938: 437) found that juncos averaged between 18.9 and 23.2 grams during the fall and winter months. Under conditions of starvation, Kendeigh (1945: 223) found that juncos weighed 16.0 grams at − 14° C. and 14.9 grams at − 3° at the time of death. Since our birds weighed from 18.5 to 20.7 grams at all temperatures investigated, the conclusion is warranted that they were maintaining an energy balance well above that of minimum existence. On the 15-hour photoperiod, the weights of the junco did not vary significantly from 22° to − 13°. This indicated that the increase in food consumption was utilized for increased heat production. On the 10-hour photoperiod there was a gradual increase in weight from 18.5

grams at 22° to 18.9 grams at 10° to 20.0 grams at − 13°. The latter rise was 3.2 times the standard error. The conclusion would be that the birds were consuming more than necessary for existence and that this excess was being stored. However, the birds used at 10° C. were not the same individuals used at − 13°.

Data (Baldwin and Kendeigh, 1938: 436–437) showed that the average weight of white-throated sparrows varies from 25.1 grams to 29.4 grams from September to May. Death from starvation occurred at − 17° when the birds were down to 21.7 grams (Kendeigh, 1945: 223) and at − 1° when the weight was 20.2 grams. Our data show that the birds at 22° were well within the range of weights for free individuals out-of-doors. At − 13° there was a pronounced drop in weight of birds on the 10-hour photoperiod. The loss, from 27.7 grams to 22.2 grams, was 7.5 times the standard error. The latter weight was near the weight of birds dying from starvation at low temperatures. The birds were continuing to lose weight when the experiment was terminated. These results clearly indicate that a 10-hour photoperiod at a temperature of − 13° C. was causing difficulty in maintaining a prolonged energy balance, even though these birds were able to live precariously for 63 days. Such temperatures out-of-doors under natural conditions would be near, if not beyond, the environmental limits that the species could tolerate for any prolonged period. On the 15-hour day, there was a slight loss in weight, from 25 to 23.1 grams (1.7 times the standard error). Individual birds maintained a more or less constant weight throughout the experiment. The latter weight (23.1 grams), however, is only 1.4 grams greater than the weight at death from starvation at − 17°. These birds were existing at a level only slightly above the minimum, but, nevertheless, the longer photoperiod was of distinct advantage to the species.

Wild English sparrows weigh from 26 to 29 grams (Baldwin and Kendeigh, 1938: 436–437). At − 14° C. the birds die from starvation at a weight of 24.4 grams (Kendeigh, 1945: 223). Since the experimental birds used in these experiments averaged about this weight, it must be assumed that they were living at a bare existence level at all temperatures investigated.

On the other hand, as temperatures were increased from 22° to 34° C. the junco showed a significant (three times the standard error) loss in weight on the 15-hour photoperiod, but not on the 10. The white-throat lost considerable weight on both the 15- and 10-hour photoperiods (5.9 and 11.3 times the standard errors, respectively).

The English sparrow showed no significant change in weight at either photoperiod.

Kendeigh's survival data showed that juncos died at a weight of 14.6 grams at 35° C. This weight is well below the minimum of our birds. Tolerance of high temperature involves the problem of heat loss, with heat production reduced to a minimum. Kendeigh (1944: 9, and 1945: 222) has shown that the shortened survival time at high temperatures is due to inability to attain or maintain the requisite high rate of water loss. The slight drop in weight may be a result of the energy consumed in the active process of water elimination or the result of a faster decrease in feeding rate, rather than any increase in energy needs.

The extreme loss in weight by the white-throat showed that this species is less tolerant than the junco to a temperature of 34° C. Kendeigh's paper (1949) does not include data, that could be used for comparison, on the white-throated sparrows' resistance to hunger at 34°.

The English sparrow showed no significant weight change. Kendeigh's English sparrows died at 34° at a final weight of 19.6 grams, a value below the weight of our birds. This species showed a better adjustment to a high temperature than did the junco or white-throat.

To correct for the size of the bird, metabolizable energy utilization was calculated per kilogram of body weight (Table 1). In spite of their body weights being nearly the same, the rate of absorption per kilogram was generally least in the white-throated sparrow and greatest in the English sparrow and junco. Straight lines fitted to the observed points gave the following formulae, with y the calories per kilogram of weight per day and x the temperature in degrees centigrade. The critical temperature of minimum rate of metabolism is 37° C. in the English sparrow (Kendeigh, 1944: 8). The caloric value of metabolizable energy at that temperature is the basic rate to which is added the increased energy absorption at lower temperatures. The figures in front of the parenthesis represent the increase in the number of calories for each degree of temperature below 37° C.

Junco	15 hours: $y = 13.0\,(37 - x) + 596.7$
	10 hours: $y = 8.2\,(37 - x) + 603.5$
White-throat	15 hours: $y = 7.6\,(37 - x) + 647.0$
	10 hours: $y = 6.2\,(37 - x) + 559.8$
English sparrow	15 hours: $y = 4.6\,(37 - x) + 815.7$
	10 hours: $y = 10.8\,(37 - x) + 583.1$

The number of calories absorbed per kilogram at 37° was least in

the white-throat (559.8) on a 10-hour photoperiod. In the other species, whenever the value of 37° was low it was compensated by a more rapid rate of increase with drop in temperature.

Most students of bioenergetics maintain that heat production should be evaluated in terms of surface area rather than volume or weight. Therefore, metabolizable energy was determined in terms of one square meter of body surface, the latter being calculated by using Meeh's formula ($S = Kw^{2/3}$) and using a value of 10 for K. Various refinements of this formula have been proposed, but in view of the fact that a bird's body is covered with feathers and that the three species probably differ in the quality as well as the quantity of their insulating cover, these refinements appear unwarranted. The data are graphed in Figure 3.

The observed points were fitted to straight lines and the following formulae obtained, y being the calories of metabolizable energy per square meter of body surface and x the temperature in degrees centigrade.

Junco	15 hours	$y = 33.1\ (37 - x) + 1634.1$
	10 hours	$y = 23.8\ (37 - x) + 1560.2$
White-throat	15 hours	$y = 22.8\ (37 - x) + 1799.0$
	10 hours	$y = 18.4\ (37 - x) + 1603.9$
English sparrow	15 hours	$y = 19.1\ (37 - x) + 2219.3$
	10 hours	$y = 31.3\ (37 - x) + 1651.4$

In both the junco and white-throat, the rate of increase in energy absorption with drop in temperature was greater on the long day than on the short, but in the English sparrow the condition was reversed. These rates also demonstrate that the white-throat did not respond so rapidly to a drop in temperature while on a 10-hour photoperiod as did the other species. Kendeigh's data on the English sparrow (1949: 118) indicate a straight line relationship between energy absorption and temperature. The data on the juncos in this experiment, which were investigated at four temperatures, also point to a straight line as the best possible fit to the data. However, in the case of the white-throat on a 10-hour photoperiod, the birds failed to absorb any significantly greater amount of energy at − 13° C. than they did at 22°; consequently, they lost weight. Because of this reduced weight, metabolizable energy on a kilogram or square meter basis is correspondingly increased and the observed points approximate a straight line. The line in Figure 3 is drawn as being broken, however, to show that somewhere between 22° and − 13° the energy balance was upset and the relationship between food absorption and temperature was no longer truly linear (Fig. 2).

It would be expected that because of its smaller size the field sparrow would be the lightest eater, but it absorbed more metabolizable energy than the junco and the white-throat at comparable temperatures and photoperiods (Table 1). This large capacity for energy absorption is more markedly emphasized when the caloric intake is measured in relation to body weight and surface area. Wild field sparrows fluctuate between 11 and 13 grams in weight, being lightest in the summer months (Baldwin and Kendeigh, 1938: 436–437). Since this captive specimen averaged 10.7 grams, this great consumption maintained it at only a minimum existence level.

The weight of the blue jay varied between 79.0 and 80.7 grams, values well within the range for wild birds. Although restricted to a diet consisting mostly of grain, this bird survived in good health until the end of the experiment.

Water Consumption

Quantitative data on water consumption by birds are scarce. Rubner (1897: 53) pointed out that pigeons died from thirst in four to five days but that those allowed water and no food lived for 12 days. Bennion and Warren (1933: 78) measured the mean daily water consumption of chickens at 21° and 27° C. and found it to be 224 grams; at 32° it increased 3.8 per cent, to 233 grams. Mitchell and Kelley (1933: 737–738, 740) calculated water needs of chickens for drinking as—the sum of the water vaporized, the water in the excreta and the water stored in the tissues, minus the water obtained from food. At 28° C., with due corrections for moisture in the food, water analysis of the gain, and metabolic water calculated from nutrients in the feed, it was found that a one-pound chicken needed 99 grams of water per day (9.04 milligrams per gram per hour) and a five-pound chicken, 223 grams of water (4.10 milligrams per gram per hour). On the basis of these data, Lippincott and Card (1946: 267) stated that the average water intake of laying hens was about 35 to 40 pounds per 100 hens per day. Large hens, laying at a high rate in hot weather, would require 50 to 60 pounds.

In our experiments on water consumption the same type of individual cages was used, as previously described for the feeding experiments. Instead of water cups, a small crystalline dish, 1¾ by 1⅛ inches, was placed in each cage. At the higher temperatures of 34° and 37° C., 20 cubic centimeters of distilled water were put into each dish with a delivery pipette, but only 10 cubic centimeters at the temperatures of 0° and 22° C. Each dish with water was weighed to within one milligram on an analytical balance before it was given to

the bird and again at the end of the experiment. Two or three other dishes with equivalent amounts of water were set in near by positions but out of reach of the birds in order to measure evaporation. The average amount of evaporation subtracted from the total lost in the experimental dishes gave the amount of water consumed by the birds. The dishes were removed from the cages after three to seven hours. As this was the only water available to the birds for the entire day, the total drunk divided by 24 gave the rate per hour. In this case, the total day rather than just the daylight period was used to calculate

TABLE 2

CONSUMPTION OF DRINKING WATER BY THE JUNCO, WHITE-THROATED SPARROW AND ENGLISH SPARROW ON A 12-HOUR PHOTOPERIOD

Temperature (° C.)	*Number of observations*	*Period (hours)*	*Bird weight (grams)*	*Water drunk (grams)*	*24 hour period (mgm./gm./hr.)*
		JUNCO			
0	8	4.70	18.0	1.88	4.4
23	5	4.83	16.1	2.57	6.6
34	5	6.02	16.7	2.90	7.2
37	7	4.93	17.0	3.62	8.9
		WHITE-THROATED SPARROW			
0	10	4.80	25.0	4.60	7.7
23	11	4.01	23.3	6.27	11.2
37	5	4.93	21.2	9.22	18.2
		ENGLISH SPARROW			
0	7	4.33	24.7	4.04	6.8
23	8	4.42	24.9	4.31	7.2
34	4	6.34	23.9	6.39	11.1
37	3	4.89	24.3	7.99	13.7

the rate per hour, in order to render the results comparable to the published data and since water is actually being lost continually in respiration. Before readings were taken, two to three days were allowed for the bird to become acclimated to the restricted period of availability of water. The failure of the birds to lose weight indicated that adjustment was complete and that sufficient water for their needs had been consumed. The data on water consumption are given in Table 2. There is no indication in the table that the birds consistently drank more water when it was available for a longer period.

As the temperature increased, the amount of water consumed per hour also increased. The amount consumed, both absolutely and relatively, was greatest in the white-throat and least in the junco. Tests for significance of the rates of consumption among the species were made by using Student's method of analysis for small samples.

At 0° C., the white-throat and the English sparrow did not differ significantly, whereas the difference between the white-throat and the junco was highly significant. Between the English sparrow and the junco, the chance probability of the difference being as great or greater than the one observed was 2 in 100, a chance sufficiently remote to be considered significant. At 23°, the difference between the English sparrow and the junco was insignificant, but between the white-throat and the other two species, the probability was 0.03. At 37°, all differences were significant, although between the white-throat and the other two species, the probability of the difference was 0.05.

The white-throat consumed more drinking water than either the English sparrow or the junco at all temperatures investigated; this difference became increasingly greater with a rise in temperature. From 0° to 37° C. its consumption increased 136 per cent. Although relative water consumption by the junco was the least of all, it increased its daily intake by 102 per cent, an increase equal to that of the English sparrow. This greater need of water by the white-throat would seem to indicate that it is less capable of withstanding high temperatures than the other two species. This may be an important factor explaining why white-throats, under starvation conditions at 37°, survived only seven hours, whereas the junco and the English sparrow survived 12 and 15 hours, respectively (Kendeigh, 1945: 223).

Discussion

Of the many factors that control the distribution and migration of birds, the biological and physical aspects of the habitat (plants, terrain) and such climatic factors as temperature have generally been regarded as the major ones. The results of these experiments confirm the increasing evidence that photoperiod is also a major determinant. The length of day controls the feeding time available and, thereby, the amount of energy that the bird is able to obtain. Whenever the daylight period is so short that the food intake is insufficient to meet the demands of the bird's activities and to carry the bird over the night, the bird must respond by leaving the region before the environment becomes intolerable. This is especially true at low air temperatures when much energy must be expended to maintain body temperature and existence. At high air temperatures the length of day is less important, as the critical factor involved is keeping the body temperature from rising to a harmful degree.

It is, therefore, pertinent to determine whether the summer and winter distributions of the slate-colored junco, white-throated sparrow, English sparrow, blue jay, and field sparrow can be correlated with

their ability or inability for maintaining an adequate energy balance at different temperatures and photoperiods, and whether there are any distinguishable differences between migrants and non-migrants.

The data on the distribution of the first three species during the summer breeding season were collected from numerous published sources, including state lists, reports on collections, and the National Audubon Society's annual breeding-bird census. The winter distribution was determined primarily from the National Audubon Society's annual Christmas bird count. These counts are made within four days of December 25 and can, therefore, be considered as defining rather accurately the early wintering status of the species.

FIGURE 4.—Breeding range of junco, *Junco hyemalis*, in North America, with maximum photoperiods and mid-July isotherms at northern and southern limits. Summer records indicated by open circles, nesting records by solid dots.

Mid-July isotherms were drawn along the southern and northern boundaries of the breeding ranges and mid-January isotherms around the extremities of the wintering ranges. The normal ranges were determined by the preponderance of records; scattered records around the periphery were not included. The choice of the proper isotherm was made visually and may represent an error of a degree or two in either direction. Isotherms of the United States were taken from the

United States Department of Agriculture's Atlas of American Agriculture, Part II, Section B, 1928, and those of Canada from the Atlas of Canada, Department of Interior of Canada, 1915. The approximate boundaries of the northern and southern distributions during the summer and winter, the total daylight hours at those boundaries in the same seasons, and the mid-July and mid-January isotherms at those boundaries are shown in Figures 4 to 8.

To determine how these birds might respond to the extreme conditions of temperature and photoperiod that occur in their breeding ranges during the winter, a curve for each species was temporarily inserted in Figure 3 at the corresponding photoperiod. In placing this line it was assumed that the relationship existing between 10 and

FIGURE 5.—Winter range of junco, *Junco hyemalis*, in North America, with minimum photoperiods and mid-January isotherms at northern and southern limits.

15-hour photoperiods would hold for intermediate or extreme periods. Thus, a 12.5–hour photoperiod would fall halfway between the two known curves, while one of 7.5 hours would fall the same distance below that of the 10.

The data in Table 3, derived by this method, give the number of calories metabolized per bird per hour, which is the rate at which the bird would have to absorb calories at the prevailing photoperiod. This rate can then be compared with the maximum hourly rate obtained from the experimental birds.

The maximum rate of energy absorption observed for the junco was 2.0 calories per bird per hour, but it may go somewhat higher at lower temperatures. Within its normal winter range this observed maximum suffices, but it is not adequate to meet the rigorous winter conditions in its breeding range. This is also true for the white-throated sparrow. Within its wintering range the most extreme average con-

TABLE 3

CALCULATED WINTER ENERGY REQUIREMENTS OF THE JUNCO, WHITE-THROATED SPARROW AND ENGLISH SPARROW AT THE EXTREMES OF THEIR BREEDING AND WINTER RANGES

Species	*Boundary of range*	*Minimum requirements in breeding range during winter (Cal./bird/hr.)*	*Minimum requirements in winter range during winter (Cal./bird/hr.)*	*Maximum rate of absorption observed in experiments (Cal./bird/hr.)*
Junco	Northern	4.8	2.0	2.0
	Southern	2.2	1.5	
White-throat	Northern	3.3	1.9	1.9
	Southern	2.2	1.7	
English sparrow	Northern	3.1	3.1	3.3
	Southern	1.7	1.7	

dition that the white-throat must tolerate is a photoperiod of 9.3 hours at an average temperature of 0° C., requiring 1.9 calories per hour. This must represent the limit of tolerance for this species since it migrates from those parts of the breeding range where conditions of 9.2 hours at − 2° C., requiring 2.2 calories per hour, would be encountered. In both these species the average conditions existing at the northern edge of their respective winter ranges are severe enough to prevent the birds' obtaining any excess energy to meet emergencies. It is to be expected that during seasons of severe cold both of these species would be forced to move progressively farther south.

FIGURE 6.—Breeding range of white-throated sparrow, *Zonotrichia albicollis*, in North America, with maximum photoperiods and mid-July isotherms at northern and southern limits. Summer records indicated by open circles, nesting records by solid dots.

Summer conditions within the breeding ranges of these species are sufficiently favorable for them to exist without discomfort. Using energy absorption as a criterion, the white-throat can not adapt to extreme low temperatures as well as the junco (Fig. 3). It would be expected *a priori* that the former's range would not extend so far north as the latter's; this postulation is supported by the distributional data.

The English sparrow's maximum rate of 3.3 calories per hour at − 31° C., as calculated from data of Kendeigh (1949), is sufficiently fast to fulfill all its requirements within its range. Even in the far north during the winter, the average requirements are 3.1 calories per hour, and the bird would still have enough surplus for periods of stress.

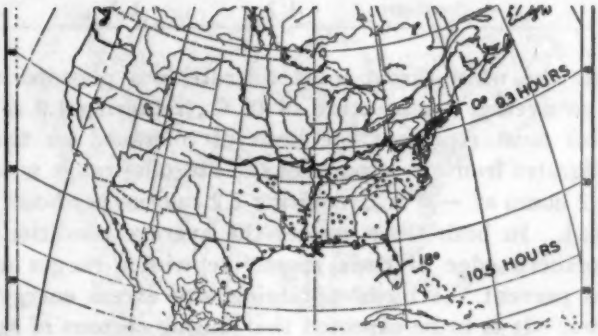

FIGURE 7.—Winter range of white-throated sparrow, *Zonotrichia albicollis*, in North America, with minimum photoperiods and mid-January isotherms at northern and southern limits.

During the winter, the short days at the cold temperatures, which caused the junco and the white-throat to migrate, do not affect the English sparrow because its rate of food consumption is stimulated to such a degree that energy intake at − 13° C. on a 10-hour day is equal to that on a 15-hour day (Fig. 3). Kendeigh (1945: 223) showed that when deprived of food the English sparrow survived only 19 hours at − 14° C. and that survival time was reduced to around four hours when the temperature fell below − 22° C. Therefore, 16 hours of darkness at − 12° C. is close to the limit beyond which it could not safely tolerate daily fluctuations that are likely to occur.

During the summer in the southern part of its range, the English sparrow is exposed to average maximum temperatures ranging up to 38° C. The migrant junco and white-throated sparrow would also be exposed to this high temperature, were they to remain in their winter ranges during the summer months. Kendeigh's data showed that the

survival period for the English sparrow at 38° C. was 15 hours; for the junco, 12 hours at 37°; and for the white-throat, 7 hours at 37°. The two-fold survival time of the first species, as compared to the white-throat, is related to the fact that the English sparrow has a more conservative water balance. Although a maximum temperature may exist for only a short period of the day, it would be of greater importance to the white-throat since it would produce a greater dehydration than in the junco and English sparrow. This fact is indicated by the extreme water requirements of this species at high temperatures (Table 2).

FIGURE 8.—Range of English sparrow, *Passer domesticus*, in North America, with maximum photoperiods and mid-July isotherms (solid lines) and minimum photoperiods and mid-January isotherms (dashed lines) at northern and southern limits.

If a more perfect water and heat regulating mechanism permits the English sparrow to remain in the south and its absence causes the white-throat to migrate north in the summer, it fails to explain the northward migration of the junco. Our data indicate that the junco has a favorable water metabolism at high temperatures, and Kendeigh's results showed this species capable of withstanding high temperatures almost as well as the English sparrow. Factors other than those discussed here must be important in regulating its behavior. Likewise, the restriction of the northward spread of the English sparrow during the breeding season must be effected by other factors than lack of energy resources.

Because of the paucity of data, any detailed discussion of the blue jay and the field sparrow would be unjustified. The blue jay is a

permanent resident species, occupying a range from 52° N. latitude south to the Gulf states and west to the 100th meridian. Its range approximates the eastern half of that of the English sparrow. At 22° C., this species was able to consume as much food on the 10-hour day as on the 15-hour day. The only other bird thus able to increase its hourly rate of food absorption to the extent needed was the English sparrow, also a permanent resident.

The field sparrow is a summer resident over only part of its range. Its breeding range extends from southern Maine, Ontario, and Manitoba to central Alabama, Mississippi, and Texas. Its breeding range is thus south of either the junco's or the white-throat's. During the winter its range is more southerly in the United States, occurring northward to about Maryland and Southern Illinois, approximately the wintering range of the white-throat. It may be that it does not occur in colder regions because its capacity for food absorption, considering its small size, has already reached its limit of maximum efficiency in the relatively warmer climate of the South.

In view of the foregoing data and discussion, certain characteristics are found to distinguish migrants and non-migrants. In the latter, English sparrow and blue jay, the hourly rate of food consumption per bird is increased and the total on the short day at low temperatures is the same as that on the long day, so that the effect of photoperiod as a limiting factor is minimized. Within certain limits, this allows a permanent resident to remain in a cold environment with short day lengths. Rising temperatures have less effect in decreasing food intake during long photoperiods for non-migrants than for migrants. This is essential if a bird is to remain where it is hot during the summer.

In contradistinction, a migrant species, such as the white-throated sparrow, is unable to stay in its breeding range because low temperatures do not stimulate a sufficiently fast hourly rate of food consumption to bring the daily total on a short photoperiod up to an amount adequate for existence. The change in photoperiod is, therefore, a primary factor causing southward migration in the fall. The field sparrow further demonstrates that some migrants have innately such a high requirement for food, even at moderate temperatures, that for physical and mechanical reasons they could not increase effectively their hourly rate of consumption to compensate for any significant drop in temperature. The more a species can increase its hourly food intake, the farther north it can be expected during the winter. Just why different species should vary in their ability to increase their hourly rate of food consumption still remains a problem. The psychological aspect of food ingestion, as indicated by Beck's (1930)

work with chickens, is apparently not to be dismissed lightly. However, it would seem more likely that a study of the comparative physiological capabilities of the digestive systems will provide the decisive answers.

As Kendeigh (1934: 396) and others have pointed out, long nights at low temperatures make it necessary for certain species of birds to migrate, and this investigation has borne out the fact that the combination of these environmental conditions has a pronounced effect on food consumption. The emphasis in this paper has been on extreme conditions. Variations within these extremes, especially a gradual change from one to the other, may have a regulatory effect on the time of migration. Variations beyond the extremes may cause the sudden disappearance or unexpected appearance of migrants outside their usual time and place or may have catastrophic effects on segments of a population.

SUMMARY

1. The food consumption of the slate-colored junco, white-throated sparrow, and English sparrow was measured at temperatures ranging from 34° to − 13° C. and at photoperiods of 10 and 15 hours. The food consumption of a field sparrow and a blue jay was measured at 22° C., on a 15- and 10-hour day for the latter and on a 15-hour day for the former.

2. The gross energy consumed per day by the junco, white-throat, and English sparrow increased at different rates with decreased temperatures.

3. The gross energy consumed per hour was greater on the 10-hour photoperiod than on the 15-, but this greater rate of food consumption was not sufficient in most instances to make the total energy consumed during the day equal to that consumed on the longer photoperiod. The blue jay at 22° and the English sparrow at − 13° C. were, however, able to consume as much during the short day as during the long day.

4. The energy lost per gram of dry feces was greatest at 34°–37° C. in the junco, white-throat, and English sparrow and least at 22°. The energy lost in the feces per day per bird decreased with a rise in temperature up to 22°, but above 22° it varied with the species and the photoperiod.

5. The metabolizable energy absorbed by the junco, white-throat, and English sparrow on a 10-hour day increased at the average rate of 8.2, 6.2, 10.6 calories per gram per day, or 23.8, 18.4, 31.3 calories per square meter per day per degree drop in temperature, respectively.

On a 15-hour day the corresponding rates were 13.0, 7.6, 6.7 calories per gram per day and 33.1, 22.8, 19.4 calories per square meter per day. The energy absorbed by a field sparrow at 22° C. was considerably more than by the other species, when compared in terms of unit weight or surface area.

6. Water consumption by the English sparrow, junco, and white-throat was measured at temperatures from 0° to 37° C. At all temperatures, the white-throat drank the most water and the junco the least.

7. These experimental results, when interpreted in terms of winter conditions in the breeding ranges of the junco and white-throat, indicate that migration south in the fall may be induced because decreasing photoperiods and colder temperatures combine to prevent the birds from absorbing sufficient food to maintain an energy balance over the 24-hour day.

8. The English sparrow and the blue jay are not forced to migrate south in the autumn because short photoperiods at low temperatures induce a rate of energy absorption sufficiently great to minimize the effect of the shortened day-length. High temperatures at long photoperiods do not reduce the energy absorption in the English sparrow to the same extent as in a migrant species.

9. The field sparrow may be limited in its northward migration and distribution by its innately high food requirements.

10. Northward migration in the spring in the white-throat may be influenced by a delicate water balance that is easily upset by high temperatures.

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ADDITIONAL DATA ON VICTIMS OF PARASITIC COWBIRDS

BY HERBERT FRIEDMANN[1]

SINCE the last compilation of hosts of cowbirds (Auk, 1943: 350–356), a number of additions have come to my attention, some in publications and some by way of personal correspondence. No attempt has been made to re-identify any of the old records in light of the changes in racial forms recognized in the various supplements to the last A. O. U. Check-List; that may well wait until the 5th edition of the Check-List is published. As might be expected, the present additions to the list of birds known to be parasitized by cowbirds make no very important alterations in the general, overall picture, but they are of interest in themselves as bearing on the interrelations between the economy of the parasite and of each particular host species. In the following annotated lists are discussed not only those birds new to the roster of victims but also a few others on which important new data have been gathered.

Molothrus bonariensis (Gmelin). SHINY COWBIRD.

To the 163 species and subspecies of birds listed as victims of the various races of the shiny cowbird, we may now add 14 more, bringing the total up to 177. These hosts involve four races of the cowbird, as follows:

1. *Molothrus bonariensis bonariensis* (Gmelin). ARGENTINE SHINY COWBIRD.
   Metriopelia melanoptera melanoptera Molina. Black-winged Dove.
   Hymenops perspicillata andina Ridgway. Chilean Spectacled Tyrant.
   Xolmis pyrope pyrope (Kittlitz). Fire-eyed Pepoaza.
   Passer domesticus domesticus Linnaeus. English Sparrow.
   Phrygilus patagonicus Lowe. Patagonian Gray-headed Finch.
   Paroaria gularis gularis (Linnaeus). Black-throated Cardinal.

The known hosts of this race of the parasite now total 121 forms.

2. *Molothrus bonariensis minimus* Dalmas. SMALL SHINY COWBIRD.
   Vireo virescens vividior Hellmayr and Seilern. Caribbean Vireo.

We now have records of 27 forms of birds as victims of this cowbird.

3. *Molothrus bonariensis venezuelensis* Stone. VENEZUELAN SHINY COWBIRD.
   Troglodytes musculus clarus Berlepsch and Hartert. Pale-billed House Wren.
   Turdus leucomelas albiventer Spix. Spix's Thrush.
   Tachyphonus rufus (Boddaert). Greater White-shouldered Tanager.
   Zonotrichia capensis venezuelae Chapman. Venezuelan Chingolo.

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Previously, only three birds had been listed as victims of the Venezuelan shiny cowbird; with these records the list is increased to seven.

4. *Molothrus bonariensis cabanisii* Cassin. CABINIS' SHINY COWBIRD.
Dendroplex picus dugandi Wetmore and Phelps. Dugand's Plain-throated Wood-hewer.
Campylorhynchus minor albicilius (Bonaparte). White-throated Cactus Wren.
Thryothorus leucotis leucotis Lafresnaye. White-eared Wren.
Icterus nigrogularis nigrogularis (Hahn). Yellow Oriole.
Saltator coerulescens plumbeus Bonaparte. Plumbeous Saltator.

The known victims of this Colombian race of the cowbird now total eight forms. Fuller data on these new hosts and on a few of those previously so recorded are as follows:

Metriopelia melanoptera melanoptera Molina. Black-winged Dove. —One record. Goodall, Johnson, and Philippi (1946: 130) have one record of a cowbird egg being taken from a nest of this dove in Chile. The species can hardly be a host frequently used and probably would be unable to rear a young cowbird.

Dendroplex picus dugandi Wetmore and Phelps. Dugand's Plain-throated Wood-hewer.—Dr. Armando Dugand informed me (*in litt.*) that he once found an egg of *Molothrus b. cabanisii* in a nest with two eggs of this wood-hewer at Hacienda "El Paraiso," Dept. Atlantico, Colombia. The record is decidedly unusual for the parasite, as the nest was in a hole in a tree, probably an old woodpecker's nest. The nest entrance was about four meters above the ground, and the nest cavity was lined with kapok-like silky down from pods of *Bombax Ceiba* L., a common tree in the area. This record was first published (Dugand, 1940: 29) under the then current name for the wood-hewer, *Dendroplex picirostris picirostris*.

Hymenops perspicillata andina Ridgway. Chilean Spectacled Tyrant.—The nominate race of this flycatcher was known as a rarely imposed-upon victim of the cowbird in Argentina; the Chilean form is now similarly recorded. Goodall, Johnson, and Philippi (1946: 130) listed one egg of *Molothrus b. bonariensis* taken from a nest of this tyrant.

Xolmis pyrope pyrope (Kittlitz). Fire-eyed Pepoaza.—A nest containing two eggs of the cowbird, was found at Dunas de Llico, Chile, September 18, 1928, and recorded by Rafael Barros Valenzuela (1946: 103). Goodall, Johnson, and Philippi (*loc. cit.*) also implied that this bird, locally called "diucón," is victimized in Chile, but gave only one specific record.

Campylorhynchus minor albicilius (Bonaparte). White-browed Cac-

tus Wren.—One instance of this wren as a host of the cowbird in Colombia has been observed by Dr. Armando Dugand, to whom I am indebted for this information.

Troglodytes musculus clarus Berlepsch and Hartert. Pale-bellied House Wren.—R. Aveledo Hostos (1947: 50) wrote that, according to Eduardo Röhl, this wren is victimized by the Venezuelan race of the shiny cowbird. It had previously been known to be parasitized by the small shiny cowbird, *M. b. minimus*, in Trinidad.

Thryothorus leucotis leucotis Lafresnaye. White-eared Wren.—One record. At La Raya, Colombia, on January 22, 1948, Mr. M. A. Carriker, Jr. found a nest of this wren with two eggs of the wren and one of the local race of the cowbird (*cabanisii*). He collected the set, but unfortunately most of the eggs were lost in transit in the field.

Mimus thenca (Molina). Chilean Mockingbird.—To the little that was previously on record concerning this mockingbird as a molothrine victim, we may add one more instance, observed at Llico, Chile, October 29, 1931, by Rafael Barros Valenzuela (*op. cit.*, p. 105). The cowbird is, of course, the nominate subspecies.

Turdus leucomelas albiventer Spix. Spix's Thrush.—R. Aveledo Hostos (1947: 50) found a parasitized nest of this bird at Caracas, Venezuela. The cowbird there is *M. b. venezuelensis*. This nest was on the window sill of the Phelps Museum. Mr. Phelps wrote me that the same nest was used again the next year (1948) and was again parasitized, containing, at the time of his letter (April 28), two eggs of the thrush and one of the cowbird.

Vireo virescens vividior Hellmayr and Seilern. Caribbean Vireo.—Recorded as a victim of the shiny cowbird (subspecies *minimus*) in Trinidad by Belcher and Smooker (1937: 527). This form was inadvertently left out of my 1938 and 1943 papers.

Passer domesticus domesticus Linnaeus. English Sparrow.—This introduced bird has been recorded as a victim of the shiny cowbird in Chile on one occasion by Goodall, Johnson, and Philippi (*loc. cit.*).

Icterus nigrogularis nigrogularis (Hahn). Yellow Oriole.—Dr. Dugand found an egg of *Molothrus bonariensis cabanisii* in a nest of this oriole in the Magdaleno-Caribe area, Colombia (1940: 29).

Tachyphonus rufus (Boddaert). Greater White-shouldered Tanager.—Previously known as a victim of the small shiny cowbird (*minimus*), this tanager is now listed as a host of the Venezuelan race as well. R. Aveledo Hostos (*loc. cit.*) found it to be parasitized at Caracas, Venezuela.

Saltator coerulescens plumbeus Bonaparte. Plumbeous Saltator.—I

was informed by Dr. Dugand that he has found this finch to be victimized by the cowbird, *M. b. cabanisii*, in Colombia.

Phrygilus patagonicus Lowe. Patagonian Gray-headed Finch.—In Chile, this finch has been found to be victimized by the cowbird (nominate race) by Rafael Barros Valenzuela (*op. cit.*, p. 105–112) who found several parasitized nests.

Paroaria gularis gularis (Linnaeus). Black-throated Cardinal.—At Conceição do Araguaya, Brazil, E. G. Holt collected three parasitized sets of eggs of this bird, November 11, 15, and 17, 1926. These sets, each of which contained one egg of the cowbird in addition to one, two, and three, respectively, of the host, are now in the collections of the United States National Museum.

Zonotrichia capensis venezuelae Chapman. Venezuelan Chingolo.—Mr. W. H. Phelps informed me (*in litt.*) that at Caracas, Venezuela, on August 30, 1947, he found a nest of this sparrow containing an egg of the Venezuelan race of the cowbird, *M. b. venezuelensis*.

Diuca diuca diuca Molina. Diuca Finch.—While this finch was previously known as a molothrine victim in Chile, it was not possible to realize how important a role it plays in the economy of the cowbird there, or, *vice versa*, how important the parasite is in the life of the diuca. However, Goodall, Johnson, and Philippi (*loc. cit.*) stated that of 100 nests found with eggs of the cowbird in them, no fewer than 72 were of the diuca finch. It is safe to say, therefore, that this bird is the chief mainstay of the cowbird in Chile, and it would seem that the cowbird must be among the main checks on the increase of the diuca finch.

Molothrus ater (Boddaert). NORTH AMERICAN COWBIRD.

Of the North American cowbird the known hosts numbered 267 species and subspecies of birds in 1943. In the five years since then nine more forms have been found to be affected by the parasite, bringing the present total to 276 kinds of victims. All three races of the cowbird are involved in these additions, and the hosts new to each of them are listed below. Those that are new to the species as a whole are marked with an asterisk.

1. *Molothrus ater ater* (Boddaert). EASTERN COWBIRD.
   Hylocichla fuscescens salicicola Ridgway. Willow Thrush.
   **Ammospiza maritima maritima* (Wilson). Seaside Sparrow.

The known hosts of the eastern cowbird now total 153 species and subspecies.

2. *Molothrus ater artemisiae* Grinnell. NEVADA COWBIRD.
   **Anthus spragueii* (Audubon). Sprague's Pipit.

Vireo solitarius plumbeus Coues. Plumbeous Vireo.
Vermivora ruficapilla ruficapilla (Wilson). Nashville Warbler.
**Agelaius phoeniceus utahensis* Bishop. Utah Red-winged Blackbird.
**Junco aikeni* Ridgway. White-winged Junco.
**Junco hyemalis cismontanus* Dwight. Cassiar Junco.
**Melospiza melodia merrilli* (Brewster). Merrill's Song Sparrow.
**Melospiza melodia inexpectata* Riley. Riley's Song Sparrow.

These eight raise the total of known hosts of this race of the cowbird to 109 forms.

3. *Molothrus ater obscurus* (Gmelin). DWARF COWBIRD.
**Vireo vicinior* Coues. Gray Vireo.
**Dendroica occidentalis* (Townsend). Hermit Warbler.

With these two additions, the victims of the dwarf cowbird come to 100 species and subspecies.

Aside from the data on these additional hosts, a sizeable quantity of information regarding previously recorded, but little known, victims has been brought together. All these bits of information are appended in the following annotated list.

Coccyzus americanus americanus (Linnaeus). Yellow-billed Cuckoo.—Previously known as a cowbird victim only by its being so listed by Bendire on the basis of Louck's record in Illinois, the yellow-billed cuckoo has been found to be parasitized at Buckeye Lake, Ohio, by Trautman (1940: 273, 293) who recorded a nest containing five eggs of the cuckoo and one of the cowbird.

Sayornis saya saya (Bonaparte). Say's Phoebe.—To the two previous records we may add a third, a parasitized nest found in Decatur County, Kansas, June 6, 1941, by H. L. Heaton. The cowbird is of the nominate subspecies.

Iridoprocne bicolor (Vieillot). Tree Swallow.—Robbins (1947: 135) reported a nest with seven eggs of the swallow and one of the cowbird, in Oconto County, Wisconsin, June 13, 1947, found by Carl Richter. It is strange indeed, that all of the few records of this bird as a molothrine host should be from Wisconsin. Years ago I suggested (The Cowbirds, 1929: 234) the possibility that the tree swallows in some places in Wisconsin might use shallower holes in which to nest than in most other areas, but no pertinent data on this point have come to my attention.

Baeolophus atricristatus sennetti Ridgway. Sennett's Titmouse.—A. J. Kirn wrote me that he collected a set of this species with two eggs and one dwarf cowbird's egg at Somerset, Texas. This is the second instance, known to me, of this titmouse being parasitized. In his notes Kirn stated that there evidently was a disturbance at this

nest, for one of the titmouse eggs was punctured and the nest somewhat disarranged; the titmouse deserted it.

Hylocichla fuscescens salicicola Ridgway. Willow Thrush.—Previously known as an uncommon victim of the Nevada cowbird, this thrush is now added to the list of hosts of the eastern cowbird as well. Robbins (1947: 136) reported a nest in Oconto County, Wisconsin, which was deserted by its owners after the intrusion of a cowbird's egg.

Anthus spragueii (Audubon). Sprague's Pipit.—One record, Todd (1947: 417) found this pipit to be parasitized by the Nevada cowbird in southern Saskatchewan, a nest containing three eggs of the pipit and two of the parasite found at Last Mountain Lake, May 29, 1932, by Albert C. Lloyd.

Vireo vicinior Coues. Gray Vireo.—Hanna (1944: 244) found a nest of this vireo with two eggs of its own and one of the dwarf cowbird, on June 4, 1944, at Cajon Pass, northwest of San Bernardino, California. This is the first instance, known to me, of this species being affected by the cowbird.

Vireo solitarius plumbeus Coues. Plumbeous Vireo.—Known as a victim of the dwarf cowbird, this bird may now be added to the hosts of the Nevada cowbird as well. Miller (1948: 92) saw some of these vireos raising young cowbirds in the open pine woods of Powder River County, southeastern Montana, in June, 1947.

Vireo virescens flavoviridis Cassin. Yellow-green Vireo.—This bird was known as a victim of the dwarf cowbird on the basis of its being so mentioned by Salvin and Godman (1886: 451), but it was only recently that I found the basis for this statement. Lawrence (1874: 280), quoting Grayson, wrote that near Mazatlan, Sinaloa, this bird is "the preferred host" of the dwarf cowbird.

Vermivora chrysoptera (Linnaeus). Golden-winged Warbler.—Because of the still small number of cases on record for this warbler as a cowbird host, it may be mentioned that Robbins (*op. cit.*) reported two parasitized nests in Oconto County, Wisconsin, found in 1947 by Carl Richter.

Vermivora ruficapilla ruficapilla (Wilson). Nashville Warbler.—Cartwright (1931: 185) found a nest with two eggs of the warbler and three of the cowbird, in Manitoba. The cowbird in question is of the race *artemisiae*, for which form this is a new host record. The warbler was previously known as an uncommon dupe of the eastern cowbird.

Parula americana americana (Linnaeus). Parula Warbler.—In 'The Cowbirds' (1929: 240–241) I listed the typical form of the parula warbler as a cowbird victim, solely on the basis of its being so mentioned in Oberholser's unpublished manuscript on the birds of Texas.

Recently, I have had the opportunity of looking over the notes on Maryland birds of the late F. C. Kirkwood and found that on May 21, 1915, near Ocean City, Maryland, he collected a nest of this bird with four eggs of its own and one of the cowbird. This substantiates my earlier action in including this warbler in the list of hosts of the eastern cowbird. It is also known to serve as a dupe for the dwarf cowbird.

Dendroica occidentalis (Townsend). Hermit Warbler.—This warbler is added to the known victims of the dwarf cowbird on the basis of a young fledgling of a parasite seen being attended and fed by a pair of hermit warblers at Camp Augusta, three miles from Nevada City, California, June 21, 1942, by Ariel Reynolds (1942: 28).

Oporornis philadelphia (Wilson). Mourning Warbler.—To the few data previously assembled may be added a few more cases. Robbins (*op. cit.*) reported two parasitized nests in Oconto County, Wisconsin, found in 1947 by Carl Richter. Devitt (1944: 83) reported a nest with two eggs of the owner and one of the cowbird at Minesing, Ontario, June 9, 1929 (also recorded by Baillie and Harrington in 1937).

Agelaius phoeniceus utahensis Bishop. Utah Red-winged Blackbird.—One record. Bee and Hutchings (1942: 82) recorded a nest of this race of the red-wing with an egg of the Nevada cowbird at Lake, Utah, June 30.

Euphagus carolinus (Müller). Rusty Blackbird.—To the few cases previously recorded, we may add two more, unfortunately without detailed data. In his price list of November, 1947, the dealer, C. H. Gowland of Wirral, England, listed two parasitized sets of this blackbird. Further correspondence has failed to obtain either the specimens or further data about them.

Piranga rubra rubra (Linnaeus). Summer Tanager.—To the small number of records previously assembled, we may add five more, all from near Dorchester, Maryland, each with three eggs of the tanager and one of the cowbird, June 7 to 26 (1892–1920), and all from the late F. C. Kirkwood's manuscript notes on Maryland birds.

Junco aikeni Ridgway. White-winged Junco.—Miller (1948: 92) found two parasitized nests in the open pine woods of Powder River County, four miles west of Fort Howes Ranger Station, near Otter, southeastern Montana, in late June, 1947. The cowbird involved is of the race *artemisiae*. One of the nests contained one egg of the junco, one of the cowbird, and one young of each; the other held two junco eggs and two young cowbirds.

Junco hyemalis cismontanus Dwight. Cassiar Junco.—This race of the junco is added to the list of victims of the Nevada cowbird on

the basis of a statement by Munro and Cowan (1947: 205) that they found it to be parasitized at Swan Lake, Peace River, British Columbia, June 2, 1938.

Ammospiza maritima maritima. Seaside Sparrow.—Bagg and Eliot (1937: 634, footnote) stated that this sparrow was recorded as a fosterer of the cowbird on Martha's Vineyard by Mrs. Seth Wakeman. In answer to an inquiry of mine, Mrs. Wakeman kindly gave me the following details. She and another observer, Roger Baldwin, watched a seaside sparrow closely followed by a well-grown young cowbird. "The poor creature was put to it to satisfy the demands of this infant so much larger than herself, and ran about looking for food while the 'baby' kept up a constant complaint. There were no signs of any young seaside sparrows anywhere, just this ill-assorted pair." The date was August 24, 1936, and the place was the edge of a sort of drainage canal running from Black Point Road to West Tisbury Pond.

The cowbird ordinarily does not penetrate brackish or salt water marshes, and so probably very rarely foists any of its eggs on the birds that nest in such places. The seaside sparrow would appear, then, to be an unusual, and rarely imposed upon, victim.

Zonotrichia leucophrys leucophrys (Foster). White-crowned Sparrow.—In the Bulletin of the Jourdain Society, no. 6: 50, Dec., 1947, it was stated that a set of eggs of Gambel's sparrow, *Zonotrichia leucophrys gambelii*, with four cowbird eggs was exhibited at a meeting of the Society by Mr. Lings. On writing to the exhibitor, not only was I promptly given the complete data, but even the eggs were sent to me for examination. The set was collected near Okotoks, southern Alberta, June 11, 1930, by Mr. Lings. The locality precludes the possibility of the host being *gambelii*, and makes it out to be typical *leucophrys*. As a matter of fact, there is another parasitized set of *leucophrys* eggs from the same place in the collections of the Royal Ontario Museum of Zoology, at Toronto. This record is the third I know of for the Nevada cowbird and white-crowned sparrow combination.

Melospiza melodia morphna Oberholser. Rusty Song Sparrow.—A second record of this song sparrow as a victim of the Nevada cowbird has come to my attention. Gullion (1947: 145) saw a rusty song sparrow feeding a young cowbird at Eugene, Oregon, in late May, 1946.

Melospiza melodia merrilli (Brewster). Merrill's Song Sparrow.—One record, Munro and Cowan (*op. cit.*, p. 205) found Merrill's song sparrow to be parasitized by the Nevada cowbird at Coldstream, Okanagan, British Columbia, on June 10, 1939.

Melospiza melodia inexpectata Riley. Riley's Song Sparrow.—

Another addition to the hosts of the Nevada cowbird is based on the report of Munro and Cowan (*op. cit.*, p. 205) who found this form of the song sparrow to be a victim of the parasite at Nulki Lake, British Columbia, June 23, 1945.

Tangavius aeneus (Wagler). RED-EYED COWBIRD.

Two additional hosts may be recorded for this cowbird, bringing the total number of its known victims to 36. These two are as follows:

Tyrannus melancholicus occidentalis Hartert and Goodson. West Mexican Kingbird.—One record, a nest with four eggs of the kingbird and one of the bronzed cowbird, collected at Mazatlan, Sonora, on June 14, 1882, by A. Forrer, is now in the Doe Collection at the University of Florida. The cowbird involved is of the subspecies *milleri*.

Aimophila rufescens.—Sumichrast (1869: 551) wrote that in Veracruz this sparrow is parasitized by the red-eyed cowbird. This record had somehow escaped me in earlier compilations. The cowbird is the race *aeneus* (formerly called *involucratus*).

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NOTES ON WHITE SPOTTING AND OTHER PLUMAGE VARIATIONS IN GEESE

BY HAROLD C. HANSON

FROM 1940 to 1946, staff members of the Illinois Natural History Survey have conducted investigations of the flock of Canada geese wintering at the Horseshoe Lake Game Preserve in Alexander County, Illinois. Between 1943 and 1946 the writer was engaged in this research program.

Periodic censuses were made of this flock as it gradually increased in size during the autumn. These censuses as well as trapping activities afforded opportunity to scan the flock carefully for varieties of geese other than the greater Canada goose, *Branta canadensis interior* Todd, which made up the flock, and to note any unusual plumages. During the latter years of the study a surprising number of individuals showing unusual plumage variations, particularly white spotting, were observed and in some instances trapped.

The author appreciates the suggestions made by Dr. A. V. Nalbandov and Dr. Harvey I. Fisher.

SPECIES REPORTED

An extensive summary of atypical plumages in wild geese was previously made by Gladstone in 1926. He was able to learn of the existence of only 14 specimens of white and white marked geese. He cited Leverkuhn's earlier failure to find atypically colored geese in north European museums. Gladstone also summarized notes on a number of individuals observed but not collected. Seven of the nine species of waterfowl which he listed belong to the tribe Anserini (geese and swans). These species are: Canada goose, *Branta canadensis;* barnacle goose, *Branta leucopsis;* brant, *Branta bernicla;* bean and pink-footed geese, *Anser fabalis;* gray lag goose, *Anser anser;* white-fronted goose, *Anser albifrons;* and the blue goose, *Anser caerulescens.* This list accounts for seven of the 13 species as listed by Delacour and Mayr (1945: 37). Although Gladstone was apparently unaware of several American references, no new species can be added to this list.

WHITE SPOTTING

The terms "albino" and "partial albino" are frequently found in the ornithological literature in reference to individuals that are white or partially white over areas of the body that are normally pigmented. The first term is often misused, while the second "partial albino" is

entirely incorrect from a strictly genetical standpoint, the term "white spotting" being the correct one to designate partly unpigmented individuals.

To rank as a true albino, the skin, the feathers and the eyes of an individual must be completely deficient of pigment. It is questionable whether any specimens of true albino geese are known. Although Gladstone (1926) has recorded a number of white geese (Table 1) he could not state whether or not the eyes (irides) were pigmented, since most of the records consisted of museum skins or inadequately studied birds in the wild. For the present it would seem best to regard previously reported white geese as extreme examples of white spotting.

Cream-colored individuals with a whitish wash over the entire body, but usually showing some degree of "ghosting" of the normal coloration pattern, are more common than pure white individuals, both as to the number of species represented and as to the frequency of occurrence within the species (Table 1).

Geese exhibiting the piebald pattern of white spotting may be grouped according to the distribution of white on the body. In most individuals the white is limited to one of the following areas: head; head and neck; entire body excluding head and neck; under parts of body alone; and wings. The distribution of white in many of these piebald geese may be related to the location of pigmentation centers in birds as described by Allen (1914: 550).

Canada geese having unusual amounts of white on the head and on the neck are not uncommon at Horseshoe Lake (Plate 1, B and Plate 2, A). In a flock that has varied from 26,000 to 50,000 in number, from 1943 to 1946, the writer has usually seen two or three prominently marked geese of this type each year.

On two occasions, November 3 and 4, 1943, Paul S. Smith and the writer observed a goose with the entire black neck stocking liberally flecked with white feathers. On October 24 and 30, 1944, another individual showing the reverse of the above condition was observed; that is, the head and neck appeared entirely white except for flecking by relatively small numbers of black feathers and a narrow vertical stripe of black behind the jaw. An intermediate stage of white spotting on the head and neck is shown in Plate 1, A. An unusual variation of white spotting on the neck is the checkerboard pattern, Plate 2, B.

A narrow band of white or whitish feathers across the forehead is not infrequent in the Horseshoe Lake population. Elder (1946: 101) found it in three per cent of the population he sampled at the Horseshoe Lake Game Refuge. A more extreme variation of this type of

TABLE 1—SUMMARY OF GEESE EXHIBITING WHITE SPOTTING

Species	*All white, whitish or creamy white individuals*	*Piebald Individuals*		
		Head and neck	*Body, wings and tail*	*Miscellaneous*
Canada goose *Branta canadensis*		3, Gladstone, 1926; occasional, Elder, 1946; this study	Taverner, 1908; Blakiston, 1863; Murray, 1933 (also neck brownish gray); this study	Some primaries only, this study; under-wing coverts, Elder, 1946, and this study
Barnacle goose *Branta leucopsis*	Whitish: 1, Gladstone, 1926			
Brant *Branta bernicla*	White: 1, Gladstone, 1926			White wings, Gladstone, 1926
Bean goose *Anser fabalis*	Pale buff: 1, Gladstone, 1926 Cream colored, pink feet: 1, Gladstone, 1926			
Pink-footed goose *Anser brachyrhynchus*	White: 1, Gladstone, 1926 Whitish: 1, Gladstone, 1926 Cream colored: 1, Gladstone, 1926			
Grey lag goose *Anser anser*	White: 3, Gladstone, 1926		Upper body, some primaries, tail: Gladstone, 1926	General interspersion of white feathers, Gladstone, 1926
White-fronted goose *Anser albifrons*	Creamy white shading to buff: 1, Bryant, 1914	Gladstone, 1926		
Lesser snow goose *Chen h. hyperborea*	1, Soper, 1940			

spotting was observed in an individual in 1944, in which the forehead bar continued back of the eye and joined the white cheek patches.

The wings of geese may be entirely white and the rest of the body of normal coloration, or only certain primaries or parts of primaries may exhibit spotting. Two juveniles were trapped at Horseshoe Lake, one in 1944 and the other in 1945, which exhibited white on the basal half of the primaries, Plate 1, C.

Canada geese showing excessive amounts of white on the body are relatively common at Horseshoe Lake, one or more individuals having been observed each year between 1942 and 1946. A goose having a typically colored head and neck, but with a body only a few shades less than pure white was observed at the refuge three years in succession. The tail was white, but the distal third of the primaries of this individual was dusky, and it had a dusky streak down the lower back.

A juvenile female in the Natural History Survey collection, with underparts entirely white and extending as a broad white collar around the base of the black stocking of the neck which is also flecked with white feathers, was trapped at Horseshoe Lake in 1942. A second similar specimen, a juvenile male, was trapped in the autumn of 1943 and made into a study skin by the writer. In January, 1945, a third white-breasted bird, a juvenile female, was trapped and released at Horseshoe Lake, Plate 1, F. This individual was one of a family of five observed that year, all of which appeared to be identically marked. The hereditary nature of this mutation was again illustrated the following year. On October 14, 1944, Paul S. Smith observed a family of seven at the refuge, all marked with a broad white collar at the base of the neck and a white breast shield. This same family was subsequently observed on October 23, on this occasion by Smith and the writer. Less strikingly marked geese have been shot by hunters in the vicinity of Horseshoe Lake (Elder, 1946). In Plate 2, C, a white-bellied adult male is contrasted with a more typical juvenile male.

MELANISM

The most unusual instance of melanism is that of a male Canada goose shot near Plymouth, Massachusetts, which lacked the usual whitish cheeks and throat patch. "The bird's head was entirely black, with the exception of a few small lighter colored feathers on its throat, which showed only upon a very close examination," (Kennard, 1912: 391). This goose was one of a flock of seven, presumably a family, all of which were said to be darker than usual on the side of the head.

Extreme examples of variation of the cheek patch of Canada geese in the Horseshoe Lake flock is shown in Plate 1, E.

Melanism is evidently rare in the Horseshoe Lake flock. A slightly melanistic juvenile male was trapped in 1944, Plate 2, D. Elder (1946: 101) observed partly melanistic under-tail coverts in about 17 per cent of the population.

Head Crest

The most unique mutation recorded in wild geese is the crested condition reported by Phillips (1913: 578). Three crested Canada geese, all alike, were killed from the same flock near Pea Island, North Carolina.

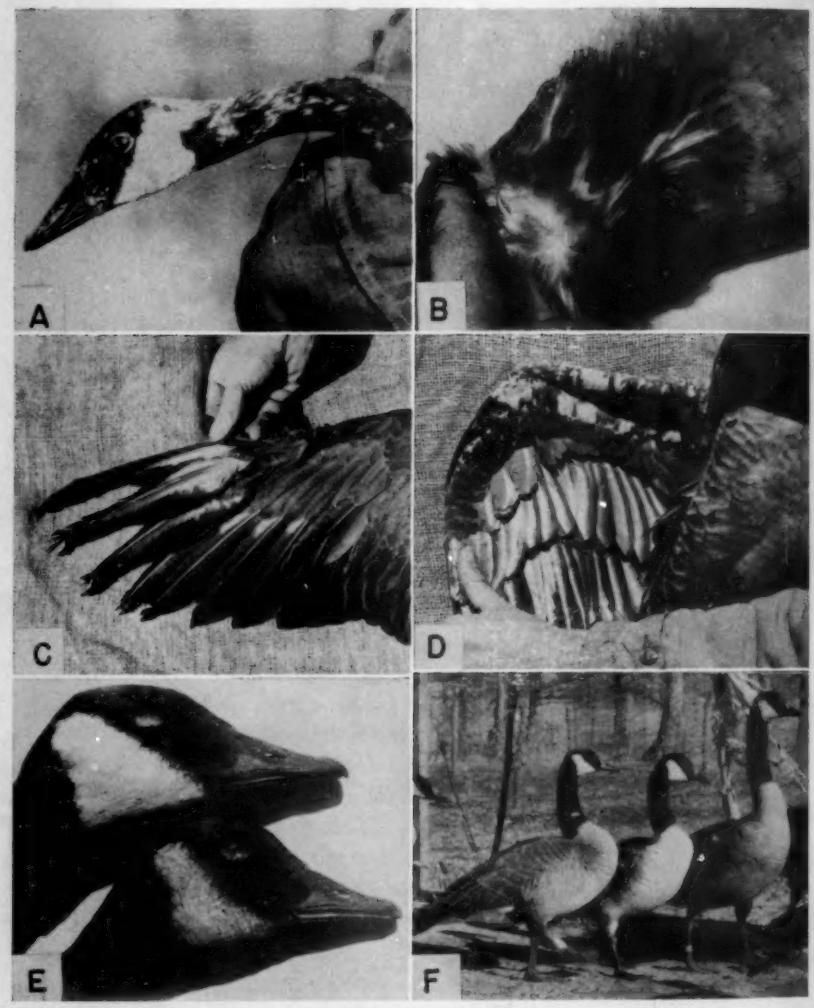
Somatic Mutations

A chimeric Canada goose was found dead near Horseshoe Lake, Illinois, in the winter of 1944–45. According to Paul S. Smith, federal game agent who found the bird, the wing shown in Plate 2, E, was the only part of the body which was in any way unusual. The remainder of the body was of the expected coloration.

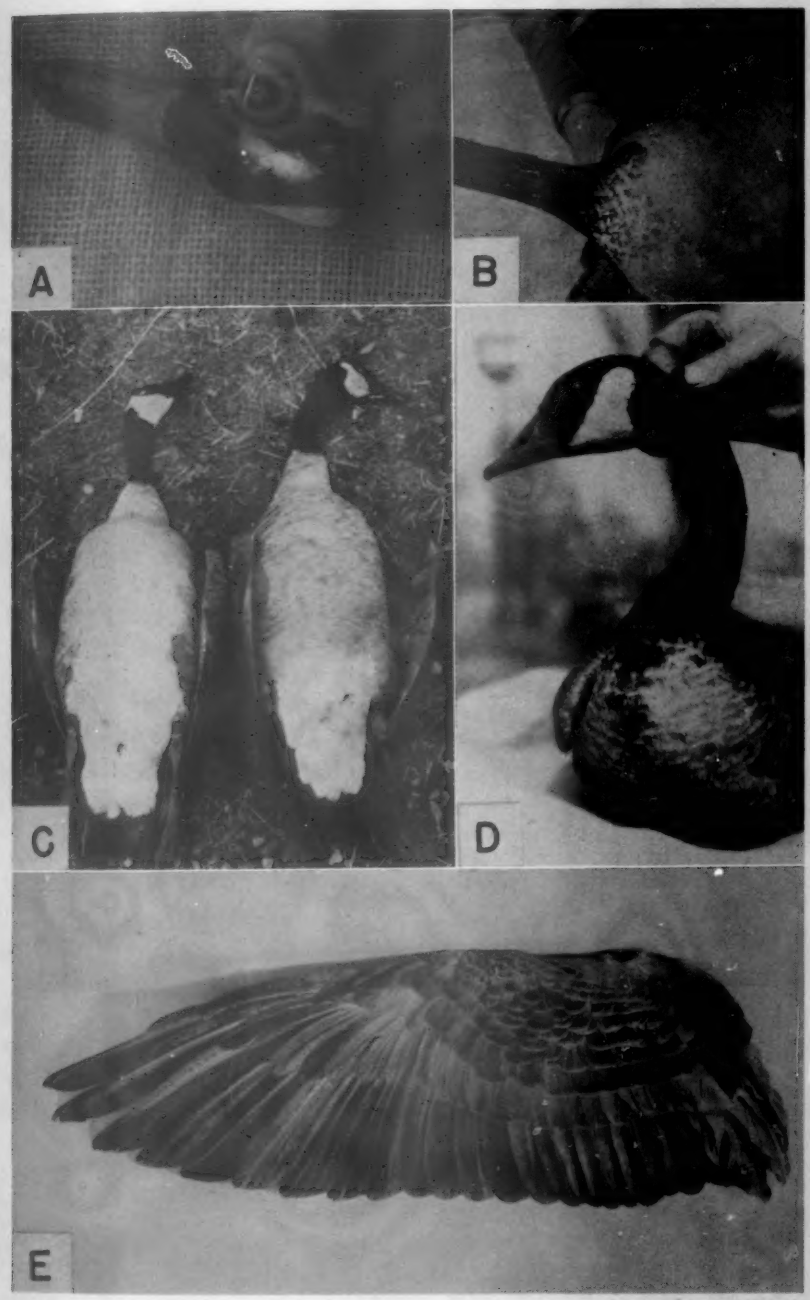
Discussion

Despite the surprising number of white or piebald geese of which he was able to obtain records, Gladstone (1926) concluded that, "There can be no doubt that albino or albinistic . . . geese are of extreme rarity, and it is surely a very odd coincidence that white examples of three different species should have been obtained within the last fifteen years on the Solway and within a perimeter of only some twenty-five miles." Shiøler reported to Gladstone that he had never observed an unusual plumaged goose and M. Menzbier had seen only one case of white spotting in Russia in his 50 years of bird study. Soper (1940: 32) stated that he believed albinism to be extremely rare in both the blue and snow geese as he had observed hundreds of thousands of these geese without noting it prior to 1940.

It would now appear, however, from the number of additional records of white spotting in geese culled from the literature and from data gathered at Horseshoe Lake, that mutations to white in geese are not so rare as once believed. With the exception of Soper, probably few workers have had the opportunity to scrutinize carefully (or trap) the large numbers of geese annually as is ideally afforded at the Horseshoe Lake Game Preserve. This may account for the supposed rarity of odd-plumaged geese. More recently, however, Witherby *et al.* (1939: 199) stated, "Occasional albinos or partial albinos



WHITE SPOTTING IN CANADA GEESE: *A*, ADULT; *B*, ADULT MALE; *C*, JUVENILE; *D*, ADULT FEMALE; *E*, *above*, ADULT MALE, *below*, ADULT FEMALE; *F*, *center*, JUVENILE FEMALE.



WHITE SPOTTING IN CANADA GEESE: *A*, ADULT MALE; *B*, ADULT; *C*, *left*, ADULT MALE, *right*, JUVENILE MALE; *D*, JUVENILE MALE; *E*, ADULT MALE (?).

of the species (pink-footed goose) occur with some regularity in large flocks and may be helpful in tracing movements."

Some types of white spotting are associated with increased age; others apparently occur only in the juvenal plumage. The most pronounced types probably appear in all successive plumages after the downy for which no data are available.

A white neck-collar and spotting on the under-wing coverts appear more frequently in older birds. Elder (1946: 101) found the white collar to be three times more frequent in older geese than in juveniles (16.6 and 4.2 per cent, respectively). The writer has found white spotting at the base of the black stocking almost entirely restricted to adults.

White spotting of the under-wing coverts occurs chiefly in Canada geese more than one year of age. Elder (1946: 101) found it in 32.2 and 37.5 per cent of the adult males and females but in only 1.5 and 1.4 per cent of the juveniles. The writer's recorded instances of spotting on the under-wing coverts (Plate 1, D) are confined almost exclusively to adults, the females demonstrating it twice as often as the males and usually to a greater degree.

On the other hand, the type of white-spotted primaries shown in Plate 1, C, may not appear in other than juvenile birds. The juvenile caught in 1945 was retrapped in November, 1946. On this occasion the wings of this individual were of normal coloration.

It is not likely that geese which have extensive white areas on their body undergo more than minor plumage changes from year to year, although records of some whitish- and cream-colored geese (Gladstone, 1926) indicate that gradual whitening may occur with increased age. The white of the white-bellied Canada geese trapped at Horseshoe Lake, however, was chalk white even in the juveniles. Maintenance of one type of piebald spotting in successive plumages was demonstrated by the white-bodied goose with a typical head and neck which returned to Horseshoe Lake in three successive years. This bird was not banded, but the writer and other observers feel certain that their observations pertained only to the same individual.

Since there has been no experimental breeding of unusual phenotypes of geese, the genetics of known examples must remain conjectural. Nevertheless, it might be well to cite a few examples of what may be parallel mutations in a few other species of animals.

Mutations to white in Canada geese, judging from known examples, do not appear to be sex-linked. In Barred Plymouth Rock chickens (Mueller and Hutt, 1941) "imperfect albinism" as demonstrated by ghost barring is sex-linked. The white, whitish and cream-colored

series in geese are reminiscent of the albinistic series of allelomorphs in the mouse (Grüneberg, 1943: 24). The genetics of the pied Canada goose described by Blakiston (1863), which had red or flesh-colored feet, a black and yellow bill and white primaries, may have been similar to the "runner" mutation reported in mallards by Jaap (1933).

In pigeons, the condition that arises when only a few feathers are affected by a somatic mutation is termed *flecking*, while birds which have extensive flecking and blotching are known as *chimeras* and are considerably rarer than individuals exhibiting flecking. Either type affects the body of the animal asymmetrically. Hollander and Cole's (1940: 39) summary of the genetic basis of chimeric pigeons may apply to the chimeric Canada goose reported here. They wrote, "Like the flecks, they mostly occur in heterozygotes, and in the majority of cases are recessive. These cases can be also explained as the result of recessive somatic mutations which have occurred relatively early in the ontogenetic development." Crew and Munro (1938) have also discussed lateral asymmetry of plumage in birds.

The relatively frequent occurrence of white spotting in geese as compared with many other kinds of birds may be related to a number of factors. Their semi-colonial nesting habits, coupled with a strong tendency to return to the same breeding grounds year after year, help to insure the isolation of breeding populations. Because of the tendency of individuals to remain paired to the same mate, there is a greater degree of reproductive isolation between various pairs of a goose population than between members of a duck population; the latter are generally believed to form new pairs each year.

Many mutant individuals that in a shorter lived species might die before reproducing their kind have in geese a better chance over the years of augmenting the number of individuals showing the mutation of the parent. The lifetime monogamy of the pair which was responsible for the white spotted phenotypes, and which presumably possess recessive genes for white spotting, increases the probability that additional white spotted offspring will be produced in future years.

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Illinois Natural History Survey, Urbana, Illinois, December 1, 1948.

NEW AVIAN RECORDS FROM NEWFOUNDLAND

BY HAROLD S. PETERS AND THOMAS D. BURLEIGH

SINCE publishing our first paper (Auk, 62: 563–566, 1945) containing additions to the 1931 edition of the A. O. U. Check-List for Newfoundland we have continued periodic visits to that country. These were in connection with the cooperative study of the bird life of Newfoundland being conducted by the Fish and Wildlife Service, United States Department of the Interior, and the Newfoundland Department of Natural Resources. We have now made six trips together to Newfoundland, mostly during the nesting season, although the fall migration and the winter birds have both been studied. The spring migration of 1947 was investigated by Burleigh, assisted by Dr. J. Fred Denton of Augusta, Georgia. Consequently, we now have personal experience with the birds of Newfoundland in each month of the year except March, November, and December. Considerable assistance has been received from residents of the country, among whom we especially wish to mention E. J. Bragg of Port aux Basques, James R. Ewing of St. Johns, Reverend A. L. Parish of Rose Blanche, Dr. Wilfred Templeman of St. Johns, and Leslie M. Tuck formerly of Placentia.

We wish to present here a number of new records of occurrence, all of which are additions to the A. O. U. Check-List (1931) or species of which the status is not sufficiently indicated in the literature. Many of these specimens were first identified by Dr. H. C. Oberholser. They were sent to him through the intense interest and activity of the late Gower Rabbitts, former clerk of game and inland fisheries for the Department of Natural Resources, St. Johns, Newfoundland. Unfortunately, most of these specimens were lost, through fire or lack of proper care, after being returned to Newfoundland at Mr. Rabbitts' request. However, their determination is recorded in the identification records of the Fish and Wildlife Service and is mentioned in correspondence files.

Most of the 49 forms in the following list are represented by specimens now in the Fish and Wildlife Service collection, United States National Museum, Washington, D. C., and are indicated by an asterisk (*) immediately following the name of each bird.

HOLBOELL'S RED-NECKED GREBE, *Colymbus grisegena holböllii* (Reinhardt).*—Casual, known from two specimens. The first was killed at Hickman's Harbour, November 18, 1932, by R. Vardy, and identified by Oberholser from only the head and feet. The second was taken at Rose Blanche in November, 1946, and determined from a foot submitted by Parish.

HORNED GREBE, *Colymbus auritus* Linnaeus.*—Casual. The first specimen was taken at Portugal Cove, Trepassy Bay, November 10, 1930, by Alfred O'Leary and was identified by Oberholser. Another was taken at Red Island, Burgeo, November 7, 1944, by Bragg and is represented by a foot.

NORTHERN PIED-BILLED GREBE, *Podilymbus podiceps podiceps* (Linnaeus).*—Casual. Three specimens have been taken: Parsons Siding, November 26, 1930, identified by Oberholser; White Bear River, November 15, 1944, by Henry Rose; and Red Island, Burgeo, December 4, 1944, by Bragg. The latter two are in the U. S. National Museum collection.

MANX SHEARWATER, *Puffinus puffinus puffinus* Brunnich.*—Accidental. A female was collected at St. Anthony, May 24, 1947, by Sgt. S. M. Christian who skinned and presented it to us. This is one of the few North American records.

MAN-O'-WAR-BIRD, *Fregata magnificens rothschildi* Mathews.—Accidental. A male was taken in Bonavista Bay about 1932. It was mounted by Ewing, in whose home it is still preserved.

GREAT BLUE HERON, *Ardea herodias herodias* Linnaeus.—Casual. We know of only one specimen, from Sandy Point, Bay St. George, May 11, 1929, by John Lizan, which was determined by Oberholser. We have not observed this species in Newfoundland, although it is quite common on near by Cape Breton Island, Nova Scotia.

AMERICAN EGRET, *Casmerodius albus egretta* (Gmelin).*—Accidental. Represented by two specimens: Pass Island, Hermitage Bay, March 14, 1936, identified by Oberholser; and Bell Island, Conception Bay, October 14, 1944, skinned and presented to us by Templeman.

SNOWY EGRET, *Leucophoyx thula thula* (Molina).*—Accidental. The first specimen was shot at Trepassey, Southern Shore, August 18, 1948, by Dr. John Kennedy, from a flock of five individuals. The wing, leg, and bill were sent to the U. S. National Museum for identification and preservation.

LITTLE BLUE HERON, *Florida caerulea caerulea* (Linnaeus).—Accidental. Two specimens are known: Bear Cove lighthouse, about June 1, 1929 (plumage not recorded); and Triton Brook, Gambo, October 5, 1936, in immature plumage, by J. M. Curran. Both were identified by Oberholser.

BLACK-CROWNED NIGHT HERON, *Nycticorax nycticorax hoactli* (Gmelin).*—Accidental. One was shot at Come-by-Chance, March 17, 1947, by Thomas Coffin.

YELLOW-CROWNED NIGHT HERON, *Nyctanassa violacea violacea* (Linnaeus).—Accidental. One was taken at Petites, on or before March 26, 1940, and determined by Oberholser.

AMERICAN PINTAIL, *Anas acuta tzitzihoa* Vieillot.—Probably nests here only rarely. A specimen reportedly from Newfoundland was shown to the Zoological Society of London, at the meeting of March 23, 1841, by E. Moore (Proc. Zool. Soc. London, 1841: 24). Three were trapped and banded in September, 1947, on the Grand Codroy River, by D. A. Benson (Wildlife Management Institute). We observed two at Stephenville Crossing, August 29, 1944, and seven on the Grand Codroy River, May 2, 1947.

BLUE-WINGED TEAL, *Anas discors* Linnaeus.—Probably nests uncommonly. The first record is of a specimen exhibited to the same meeting of the Zoological Society of London as mentioned under the pintail (*loc. cit.*). One was killed between St. Marys and Placentia Bays in the fall of 1935 and identified by Oberholser. One was trapped and banded on the Grand Codroy River on September 20, 1947, by D. A. Benson. We have observed the species near Doyles, on the Little Codroy River, and at Stephenville Crossing, all in southwestern Newfoundland.

HOODED MERGANSER, *Lophodytes cucullatus* (Linnaeus).*—Accidental. The one record is of a male taken at Portugal Cove, near Trepassy, November 15, 1937.

KING RAIL, *Rallus elegans elegans* Audubon.—Accidental. The only record is of one killed at Bally Hally, a suburb of St. Johns, October 20, 1935, which was identified by Oberholser.

PURPLE GALLINULE, *Porphyrula martinica* (Linnaeus).*—Accidental. Represented by two specimens: Torbay, May 24, 1933, identified by Oberholser; and Burgeo, May 10, 1945, by G. Shoupe, which was skinned and presented by Templeman.

FLORIDA GALLINULE, *Gallinula chloropus cachinnans* Bangs.—Accidental. Two specimens are known: near St. Johns, October 1, 1928, by Harold Clarke; and near St. Shotts, October 5, 1935, by Gus Molloy. Both were identified by Oberholser.

AMERICAN COOT, *Fulica americana americana* Gmelin.*—Casual. There are three records: one specimen from Channel, October 31, 1929, and one from Point Leamington, in the fall of 1932, were identified by Oberholser; another, probably of this species, was taken at Pass Island, Hermitage Bay, March 11, 1943, by F. J. Rideout, and the bill and one foot were presented to us by Templeman.

AMERICAN GOLDEN PLOVER, *Pluvialis dominica dominica* (Muller).—Accidental. One was killed between St. Marys and Placentia Bays in the fall of 1935, and determined by Oberholser.

ICELAND WHIMBREL, *Numenius phaeopus islandicus* Brehm.*—The second record for North America was obtained by us at Boisee Island, Pistolet Bay, June 27, 1943, (erroneously reported as *N. p. hudsonicus*, Auk, 62: 563, 1945).

HUDSONIAN CURLEW, *Numenius phaeopus hudsonicus* Latham.*—Fairly common fall migrant which we have recorded from mid-July to September 22. We collected two males on Hare Island, St. John Bay, July 28, 1944, and one male at the mouth of Little Codroy River, September 1, 1944. We have observed this species at many localities on all coasts, and Loomis (Auk, 62: 237, 1945) reported it fairly common locally and undoubtedly breeding in northern Newfoundland. This reported nesting has not been substantiated.

EASTERN WILLET, *Catoptrophorus semipalmatus semipalmatus* (Gmelin).*—Casual. A female was taken at the mouth of the Little Codroy River, May 7, 1947, by Burleigh and Denton, and a female was collected at Argentia, May 16, 1947, by Tuck who skinned and presented it to us. We observed one flying close to our boat off the tip of Bonavista peninsula on June 24, 1942. About 1000 were seen in groups on the water off the Grand Banks, in May, 1907, by Grinnell (Auk, 33: 198, 1916). Since this species nests locally in Nova Scotia, it may be found breeding in Newfoundland.

LESSER YELLOW-LEGS, *Totanus flavipes* (Gmelin).*—Casual. We know of only one specimen from Newfoundland, a male which we took on the Grand Codroy River, September 9, 1946. We observed a flock of four at Stephenville Crossing. Reports of other observations may be confused with the greater yellow-legs which is a fairly common breeding bird.

AMERICAN KNOT, *Calidris canutus rufus* (Wilson).*—Casual. We took the first specimens, a pair, at Stephenville Crossing, September 10, 1946, and another male in the same locality the following day. A female was secured by Tuck at Argentia, September 3, 1947. Our first observation was of two at Stephenville Crossing, August 28, 1944.

PURPLE SANDPIPER, *Erolia maritima* (Brünnich).*—Uncommon migrant and winter resident. The first specimen was shot at Cape Broyle, March 25, 1930, by

T. Christopher, and was determined by Oberholser. A female, from Rose Blanche, December 6, 1946, was skinned and presented by Parish. We collected two males and a female from a flock of about 40 at Argentia, February 9, 1947.

PECTORAL SANDPIPER, *Erolia melanotos* (Vieillot).*—Rare fall migrant. We took a pair at Stephenville Crossing, August 31, 1944, and a male at the mouth of Grand Codroy River, September 27, 1946. Tuck secured a male at Argentia, September 2, 1947. We observed two on Grand Codroy River, September 9, 1946, and five were reported at Gander Airport, October 8, 1941, by J. S. Cook.

WHITE-RUMPED SANDPIPER, *Erolia fuscicollis* (Vieillot).*—Fairly common fall migrant. We have obtained specimens as follows: two from Twin Island, St. John Bay, July 29, 1944; one male from Stephenville Crossing, August 30, and another on September 11, 1946; one male from the mouth of Grand Codroy River, September 4 and another on September 27, 1946. One was taken at Argentia, July 26, 1947, by Tuck who reported them first on that date. Loomis (*op. cit.*: 238) reported them as very abundant in migration at St. Anthony, and we have recorded them during July, August, and September in a number of localities.

BAIRD'S SANDPIPER, *Erolia bairdii* (Coues).*—Casual. The only specimen is a female collected at Argentia, September 14, 1947, by Tuck (Can. Field-Nat., 62: 103–112, 1948).

RED-BACKED SANDPIPER, *Erolia alpina pacifica* (Coues).*—Casual. We have secured only one specimen, a male, at Stephenville Crossing, October 2, 1946. Loomis (*loc. cit.*) reported seeing only one at St. Anthony.

EASTERN DOWITCHER, *Limnodromus griseus griseus* (Gmelin).*—Rare fall migrant. We have taken the only specimens: two males from Stephenville Crossing, August 30, 1944; and a female from the same locality, September 10, 1946. Others were seen at Stephenville Crossing, July 31, 1945, and at Grand Codroy River, September 9 and 16, 1946.

BUFF-BREASTED SANDPIPER, *Tryngites subruficollis* (Vieillot).*—Accidental. A female was collected at Argentia, September 13, 1947, by Tuck who reported two others seen at the same place (*loc. cit.*)

BLACK-NECKED STILT, *Himantopus mexicanus* (Muller).*—Accidental. One was killed at Biscay Bay, Trepassy, June 23, 1947, and sent to St. Johns by D. White.

ICELAND GULL, *Larus leucopterus leucopterus* Vieillot.*—Uncommon winter visitor. The only specimens, both in immature plumage, were killed at Rose Blanche, a male on December 17, 1946, and another male on January 24, 1947. They were skinned and presented by Parish. Wynne-Edwards reported this species along the southern coast and on the Grand Banks, the last on May 8, 1933 (Proc. Boston Soc. Nat. Hist., 40: 233–346, 1935), but he secured no specimens.

KUMLIEN'S GULL, *Larus leucopterus kumlieni* Brewster.*—Uncommon winter visitor. Three specimens from Rose Blanche have been sent to us by Parish. They are: subadult female, January 24, 1947; subadult male, November 22, 1946; and the left wing of an individual taken in March, 1946.

RING-BILLED GULL, *Larus delawarensis* Ord.*—Uncommon summer resident. We found eight nests with eggs on South Penguin Island, near Cape Freels, July 8, 1945, the first definite breeding record. The first specimens were taken by us at Stephenville Crossing in 1946: a female, September 20; a male, September 22; and a female, October 1. We have observed this species in northwestern, eastern, and southwestern Newfoundland on various dates from May 12 (1947) to October 2 (1946).

BLACK-HEADED GULL, *Larus ridibundus ridibundus* Linnaeus.*—Accidental.

One was killed at Badger, October 26, 1943, wearing a band which was placed on it as a nestling at Lake Myvatn, northern Iceland, June 16, 1943. The specimen was skinned and presented to us by Templeman.

IVORY GULL, *Pagophila eburnea* (Phipps).*—Rare winter visitor. We collected an immature male at Mobile, Avalon peninsula, January 14, 1947. A second-year bird, shot at Rose Blanche, March 11, 1947, was skinned and presented by Parish.

ARCTIC TERN, *Sterna paradisaea* Pontoppidan.*—Common summer resident, on the outer islands of all coasts. We have collected 33 specimens from at least 16 nesting colonies. A few colonies were mixed with common terns. We have found that the common terns usually nest on the inner islands and in the mouths of rivers and heads of bays, while the Arctic terns prefer the outermost islands.

SAW-WHET OWL, *Aegolius acadicus acadicus* (Gmelin).—Casual. The only record appears to be that of one taken at Colinet, early in April, 1940, and identified by Oberholser.

CHIMNEY SWIFT, *Chaetura pelagica* (Linnaeus).*—Casual. The 1931 Check-List included Newfoundland in the breeding range of this species upon unknown authority, and Bent (U. S. Nat. Mus. Bull. 176: 293, 1940) said: "There seems to be no authenticated record for Newfoundland." We believe that the first specimen known from the country is the female collected at Codroy, May 26, 1947, by Burleigh and Denton. We saw one at St. Georges, August 29, 1944, which could not be secured.

EASTERN KINGBIRD, *Tyrannus tyrannus* (Linnaeus).*—Casual. Burleigh and Denton took a female at St. Andrews, May 27, 1947. We observed another individual near Tompkins, September 6, 1946.

NORTHERN SHRIKE, *Lanius excubitor borealis* Vieillot.*—Migrant and uncommon winter resident. We have one taken at Tompkins, March 27, 1947, by Frank Tompkins, and have observed others at Tompkins in January, February, and May (1947). Rooke (Ibis, 1935: 856–879) reported receiving a specimen from Ewing at St. Johns.

BLUE-HEADED VIREO, *Vireo solitarius solitarius* (Wilson).*—Casual. Burleigh collected two females near Tompkins, September 14, 1946.

RED-EYED VIREO, *Vireo olivaceus* (Linnaeus).*—Casual. Our only specimen is a male which was killed by striking the lighthouse at Cape Anguille, September 24, 1946.

ENGLISH SPARROW, *Passer domesticus domesticus* (Linnaeus).*—Resident in many towns. We have specimens taken at Avondale, Badger, Botwood, Lewisporte, St. Anthony, Stephenville Crossing, Twillingate, and Whitbourne, and have observed them in a number of other localities along the railroad and coasts.

EASTERN MEADOWLARK, *Sturnella magna magna* (Linnaeus).—Accidental. There is only one record, St. Shotts, January 4, 1938, by P. J. Molloy, identified by Oberholser.

ROSE-BREASTED GROSBEAK, *Pheucticus ludovicianus* (Linnaeus).*—Accidental. A male was obtained at Tompkins, May 24, 1947, by Burleigh and Denton.

INDIGO BUNTING, *Passerina cyanea* (Linnaeus).—Accidental. An adult male was killed on Sound Island, Placentia Bay, about April 19, 1929, and identified by Oberholser.

EASTERN EVENING GROSBEAK, *Hesperiphona vespertina vespertina* (Cooper).*—Casual. One was taken near St. Johns, December 13, 1945. It was skinned and presented by Templeman.

Fish and Wildlife Service, United States Department of Interior, Charleston, South Carolina, and Moscow, Idaho, April 28, 1948.

THE DISTRIBUTION AND ABUNDANCE OF SHOREBIRDS ON THE NORTH AND CENTRAL NEW JERSEY COAST, 1928–1938

BY CHARLES A. URNER AND ROBERT W. STORER

CHARLES A. URNER died in June, 1938, only a week after completing the field work for his ten-year study of the migrations of shorebirds along the New Jersey coast. Summaries of his data for the years 1929 through 1934 had been published (Urner, 1929, 1930, 1931, 1932, and 1935), and some subsequent data were included in Stone's account of the shorebirds of Cape May (Stone, 1937). It, therefore, became the junior author's task to compile data for the spring flights of the years 1935 through 1938 and for the fall flights of the years 1935 through 1937, and to summarize the data for the whole ten-year period. He has attempted to follow as closely as possible the pattern set by the previously published accounts. As before, data were received from a number of trained observers including Julian K. Potter and other members of the Delaware Valley Ornithological Club, C. D. Brown, James L. Edwards, Charles H. Rogers and other members of the Linnaean Society of New York, and F. W. Loetscher, Jr. The great majority of the data were, however, those of the senior author.

TABLE 1

NUMBER OF LOCALITY COUNTS

	Northward Migration				*Southward Migration*		
	1935	*1936*	*1937*	*1938*	*1935–6*	*1936–7*	*1937–8*
Newark Meadows	15	16	14	17	39	40	35
Manasquan River	8	1	5	2	3	0	0
Seaside Park	9	2	5	1	11	4	4
Barnegat Inlet	6	4	1	1	22	9	7
Barnegat Marshes	6	3	0	0	19	14	13
Beach Haven Inlet	7	7	17	10	27	22	32
Tuckerton Marshes	13	14	16	6	30	29	32
Brigantine and Absecon	11	7	6	8	27	53	21
Totals	75	54	64	45	178	171	144

As before, the number and seasonal distribution of the trips (Tables 1 and 2) varied from year to year, and these distributions are not exactly comparable. Unfortunately, no information was left by the senior author regarding feeding conditions on the areas covered, and there is little published information concerning them. For these reasons, it is impossible to evaluate the influence of factors of this nature on the abundance and distribution of shorebirds during the period under consideration.

TABLE 2

DISTRIBUTION OF TRIPS ON WHICH SHOREBIRDS WERE SEEN

	Northward Migration					*Southward Migration*		
	1935	*1936*	*1937*	*1938*		*1935–6*	*1936–7*	*1937–8*
February	3	1	7	3	June	4	6	3
March	18	17	10	14	July	35	31	33
April	25	15	10	6	August	42	43	28
May	20	19	28	14	September	34	36	25
June	9	2	9	8	October	23	25	19
					November	24	12	15
					December	15	3	11
					January	0	7	8
					February	1	8	2
Totals	75	54	64	45	*Totals*	178	171	144

TABLE 3

RANKING OF SHOREBIRDS ON NEW JERSEY COAST AND SALT MARSHES—NORTHBOUND FLIGHT OF 1935

	Rank	*Times seen*	*Largest number on one locality trip*	*Total number, all trips*
Short-billed Dowitcher	1	14	6000	10777
Semipalmated Sandpiper	2	16	3000	5978
Red-backed Sandpiper	3	13	2500	4692
Semipalmated Plover	4	13	1000	2337
Greater Yellow-legs	5	25	450	1025
American Knot	6	5	3000	3362
Sanderling	7	12	600	1295
Black-bellied Plover	8	15	500	1280
Hudsonian Curlew	9	10	500	1570
Least Sandpiper	10	14	300	850
Piping Plover	11	16	30	193
Killdeer	12	22	20	93
Ruddy Turnstone	13	6	300	369
White-rumped Sandpiper	14	7	100	109
Spotted Sandpiper	15	12	12	46
Woodcock	16	11	4	29
Wilson's Snipe	17	8	16	27
Solitary Sandpiper	18	5	10	15
Lesser Yellow-legs	19	4	3	9
Pectoral Sandpiper	20	5	2	7
Stilt Sandpiper	21	3	1	3
Western Sandpiper	22	1	1	1
Willet	23	1	1	1
Upland Plover	24	1	1	1
Red Phalarope	25	1	1	1

The number of species and subspecies recorded in the final three and one-half years of the study follow:

	1935	*1936*	*1937*	*1938*
Northbound	25	22	26	21
Southbound	35	35	35	—
Totals	35	35	37	—

TABLE 4

RANKING OF SHOREBIRDS ON NEW JERSEY COAST AND SALT MARSHES—NORTHBOUND FLIGHT OF 1936

	Rank	*Times seen*	*Largest number on one locality trip*	*Total number, all trips*
Semipalmated Sandpiper	1	13	1800	9661
Short-billed Dowitcher	2	9	3650	6344
Black-bellied Plover	3	9	1650	3881
Red-backed Sandpiper	4	10	1000	2973
American Knot	5	7	1530	2001
Semipalmated Plover	6	9	250	788
Greater Yellow-legs	7	20	150	576
Least Sandpiper	8	8	210	628
Sanderling	9	10	200	487
Ruddy Turnstone	10	6	200	667
Killdeer	11	22	25	115
Piping Plover	12	12	20	93
Hudsonian Curlew	13	6	50	161
Spotted Sandpiper	14	7	15	53
Willet	15	1	50	50
Woodcock	16	7	5	20
Pectoral Sandpiper	17	3	9	18
Wilson's Snipe	18	5	6	16
Solitary Sandpiper	19	3	6	9
White-rumped Sandpiper	20	3	2	5
Lesser Yellow-legs	21	1	1	1
Upland Plover	22	1	1	1

The following annotated list summarizes the pertinent data for the period from February 15, 1935, to June 15, 1938. In instances where an extreme date of occurrence for a species for one year is very different from those for other years, the extreme date for the next most extreme year has been added in parentheses. The dates for the high counts, as in previous papers, are chronological, the first date for the northbound flight referring to the 1935 flight, the second for the 1936 flight and so on. In the accompanying tables (Tables 3 to 9) the

TABLE 5

RANKING OF SHOREBIRDS ON NEW JERSEY COAST AND SALT MARSHES—NORTHBOUND FLIGHT OF 1937

	Rank	*Times seen*	*Largest number on one locality trip*	*Total number, all trips*
Red-backed Sandpiper	1	20	4000	11767
Semipalmated Sandpiper	2	17	3000	11093
American Knot	3	19	1100	2044
Short-billed Dowitcher	4	9	3000	6226
Black-bellied Plover	5	24	300	930
Semipalmated Plover	6	16	600	2059
Least Sandpiper	7	18	500	897
Greater Yellow-legs	8	25	125	465
Sanderling	9	19	125	703
Killdeer	10	26	16	118
Ruddy Turnstone	11	14	100	335
Piping Plover	12	16	26	112
Hudsonian Curlew	13	5	70	128
Spotted Sandpiper	14	14	12	76
Lesser Yellow-legs	15	6	40	68
Purple Sandpiper	16	5	30	38
White-rumped Sandpiper	17	7	6	21
Woodcock	18	8	3	21
Western Sandpiper	19	6	4	12
Long-billed Dowitcher	20	2	6	10
Wilson's Snipe	21	6	2	9
Solitary Sandpiper	22	3	3	5
Stilt Sandpiper	23	2	1	2
Upland Plover	24	1	1	1
Northern Phalarope	25	1	1	1
Red Phalarope	26	1	1	1

TABLE 6

RANKING OF SHOREBIRDS ON NEW JERSEY COAST AND SALT MARSHES—NORTHBOUND FLIGHT OF 1938

	Rank	*Times seen*	*Largest number on one locality trip*	*Total number, all trips*
Semipalmated Sandpiper	1	21	3830	12178
Red-backed Sandpiper	2	14	900	3864
Sanderling	3	16	833	2184
Short-billed Dowitcher	4	9	5000	5130
Semipalmated Plover	5	17	500	1197
Black-bellied Plover	6	15	500	795
Greater Yellow-legs	7	25	100	423
American Knot	8	11	500	1086
Ruddy Turnstone	9	13	300	663
Least Sandpiper	10	10	500	586
Killdeer	11	21	10	103
Hudsonian Curlew	12	1	500	500
Piping Plover	13	12	20	91
Spotted Sandpiper	14	14	15	77
Pectoral Sandpiper	15	3	20	43
Woodcock	16	3	4	12
Lesser Yellow-legs	17	2	5	6
Western Sandpiper	18	2	4	5
Wilson's Snipe	19	3	2	5
White-rumped Sandpiper	20	3	2	4
Upland Plover	21	1	1	1

TABLE 7

RANKING OF SHOREBIRDS ON NEW JERSEY COAST AND SALT MARSHES—SOUTHBOUND FLIGHT OF 1935

	Rank	*Times seen*	*Largest number on one locality trip*	*Total number, all trips*
Semipalmated Sandpiper	1	92	1550	21430
Sanderling	2	52	1500	16473
Short-billed Dowitcher	3	70	1400	6758
Semipalmated Plover	4	77	510	5502
Lesser Yellow-legs	5	85	350	3629
Red-backed Sandpiper	6	27	1520	7609
Black-bellied Plover	7	76	440	2626
Hudsonian Curlew	8	30	1414	4337
Greater Yellow-legs	9	88	57	1183
Least Sandpiper	10	69	175	1295
Killdeer	11	89	24	690
American Knot	12	25	725	2161
Pectoral Sandpiper	13	56	80	635
Ruddy Turnstone	14	41	84	602
Spotted Sandpiper	15	55	48	551
Piping Plover	16	40	40	398
Western Sandpiper	17	46	37	349
Upland Plover	18	23	15	87
American Golden Plover	19	12	38	84
Stilt Sandpiper	20	23	15	60
Wilson's Snipe	21	19	10	52
White-rumped Sandpiper	22	26	4	40
Willet	23	20	6	51
Long-billed Dowitcher	24	9	12	34
Solitary Sandpiper	25	11	3	13
Baird's Sandpiper	26	5	3	7
Marbled Godwit	27	5	1	5
Hudsonian Godwit	28	3	2	5
Wilson's Phalarope	29	3	2	4
Purple Sandpiper	30	3	1	3
Woodcock	31	3	1	3
Red Phalarope	32	2	1	2
Wilson's Plover	33	2	1	2
Northern Phalarope	34	1	2	2
Buff-breasted Sandpiper	35	1	1	1

TABLE 8

RANKING OF SHOREBIRDS ON NEW JERSEY COAST AND SALT MARSHES—SOUTHBOUND FLIGHT OF 1936

	Rank	*Times seen*	*Largest number on one locality trip*	*Total number, all trips*
Semipalmated Sandpiper	1	89	4000	33498
Sanderling	2	66	1110	18285
Short-billed Dowitcher	3	67	1370	6761
Lesser Yellow-legs	4	79	500	5970
Greater Yellow-legs	5	84	900	3151
Semipalmated Plover	6	82	281	5013
Red-backed Sandpiper	7	27	3000	13062
Least Sandpiper	8	73	300	1879
Hudsonian Curlew	9	31	1375	5028
American Knot	10	38	1100	3925
Black-bellied Plover	11	64	150	1752
Western Sandpiper	12	69	100	826
Killdeer	13	81	50	699
Pectoral Sandpiper	14	56	135	730
Ruddy Turnstone	15	53	64	693
Piping Plover	16	44	46	557
Willet	17	43	51	401
Spotted Sandpiper	18	58	25	377
Upland Plover	19	20	45	210
Stilt Sandpiper	20	15	22	133
Long-billed Dowitcher	21	8	30	71
American Golden Plover	22	13	17	56
White-rumped Sandpiper	23	18	5	35
Wilson's Snipe	24	9	4	17
Wilson's Phalarope	25	7	1	7
Purple Sandpiper	26	4	2	6
Solitary Sandpiper	27	6	1	6
Woodcock	28	3	1	3
Baird's Sandpiper	29	3	1	3
Northern Phalarope	30	3	1	3
Hudsonian Godwit	31	2	1	2
Marbled Godwit	32	1	1	1
Red Phalarope	33	1	1	1
American Oystercatcher	34	1	1	1
Long-billed Curlew	35	1	1	1

species have been ranked, as described previously (Urner, 1935: 87), and the ranking is subject to the same inaccuracies due to duplications and other factors.

TABLE 9

RANKING OF SHOREBIRDS ON NEW JERSEY COAST AND SALT MARSHES—SOUTHBOUND FLIGHT OF 1937

	Rank	*Times seen*	*Largest number on one locality trip*	*Total number, all trips*
Semipalmated Sandpiper	1	58	1430	18114
Short-billed Dowitcher	2	36	2600	11233
Red-backed Sandpiper	3	33	2100	15351
Sanderling	4	53	1350	11141
Black-bellied Plover	5	57	1000	6911
American Knot	6	29	1600	8627
Semipalmated Plover	7	55	650	4255
Greater Yellow-legs	8	58	350	2673
Lesser Yellow-legs	9	56	270	2711
Hudsonian Curlew	10	22	1049	5055
Least Sandpiper	11	45	185	1076
Western Sandpiper	12	49	152	940
Killdeer	13	65	53	468
Ruddy Turnstone	14	37	107	730
Pectoral Sandpiper	15	29	114	633
Piping Plover	16	24	75	602
Spotted Sandpiper	17	37	33	326
White-rumped Sandpiper	18	17	35	129
Long-billed Dowitcher	19	13	40	117
Upland Plover	20	16	19	58
Willet	21	12	12	46
Wilson's Snipe	22	16	6	28
American Golden Plover	23	11	10	44
Stilt Sandpiper	24	11	6	23
Purple Sandpiper	25	6	5	16
Marbled Godwit	26	8	2	13
Solitary Sandpiper	27	8	1	8
Wilson's Phalarope	28	2	2	3
Hudsonian Godwit	29	2	1	2
Buff-breasted Sandpiper	30	2	1	2
Bar-tailed Godwit	31	2	1	2
Baird's Sandpiper	32	1	1	1
Northern Phalarope	33	1	1	1
Wilson's Plover	34	1	1	1
Curlew Sandpiper	35	1	1	1

We follow Rowan (1932) and Conover (1941) in maintaining the long-billed dowitcher as a separate species; and, as it has been established that the inland dowitcher, *Limnodromus griseus hendersoni*, occurs on the Atlantic coast in migration, it is desirable to use a vernacular to cover both races of the species. "Eastern dowitcher" is obviously inappropriate so we are using "short-billed dowitcher" which is appropriately descriptive and has the added advantage of

having been used previously. In both of these matters we are anticipating Pitelka's treatment of this genus.

Haematopus p. palliatus. American Oystercatcher.—One record, a single bird at Brigantine on September 19, 1936.

Charadrius h. semipalmatus. Semipalmated Plover.—Extreme dates: northbound, April 20 and June 8; southbound, June 15 (June 27) and January 17 (November 14). Principal movements: northbound, May 4 to June 4; southbound, July 30 to October 5. High counts: northbound, May 11, 17, 27, and 15; southbound, August 28, 31, and 14.

Charadrius m. melodus. Piping Plover.—Fall records indicate some increase over previous years. Extreme dates: March 14 and October 24. Principal southbound movement, July 4 to September 5. High counts: southbound, July 13, August 3, and July 17.

Charadrius w. wilsonia. Wilson's Plover.—Three records, September 4 and 5, 1935, and July 4, 1937, all single birds.

Charadrius v. vociferus. Killdeer.—Present all year. Numbers fairly constant. High counts: northbound, March 24, March 1, May 16, and March 27; southbound, August 30, November 8, and August 28.

Pluvialis d. dominica. American Golden Plover.—Numbers recorded vary greatly from year to year; peak of 1932 never approached again. Extreme dates: fall, July 29 and November 5. Principal movements: September 5 to October 2. High counts: southbound, September 28, September 18, and October 2.

Squatarola squatarola. Black-bellied Plover.—Present most or all the year. Apparently increasing in numbers. Principal movement: northbound, May 9 to 30; southbound, September 27 to December 5. High counts: northbound, May 18, 10, 23, and 15; southbound, September 30, November 15, and October 3.

Arenaria i. morinella. Ruddy Turnstone.—Extreme dates: northbound, February 22 and June 8; southbound, July 4 and February 7. Principal movement: northbound, May 15 to June 1; southbound, July 31 to September 8. High counts: northbound, June 1, May 30, May 29, and May 15; southbound, August 28, 15, and 14.

Philohela minor. American Woodcock.—Scattered records, on the coast. Extreme dates: March 13 and January 17.

Capella g. delicata. Wilson's Snipe.—Extreme dates: March 14 and May 17; August 8 and January 30. Principal movements not conclusively shown. High counts: northbound, April 14, 19, 11, and 9; southbound, November 3, December 27, and December 12.

Numenius a. americanus. Long-billed Curlew.—One bird seen on July 26, 1936, at Absecon in company with Hudsonian curlew with which it was compared.

Numenius p. hudsonicus. Hudsonian Curlew.—Further increase indicated. Extreme dates: northbound, April 20 and June 7; southbound, June 29 and October 10. Principal movements: northbound, May 2 to 18; southbound, July 3 to August 17. High counts: northbound, May 11, 10, 9, and 15; southbound, July 27, August 1, and July 31.

Bartramia longicauda. Upland Plover.—Numbers recorded vary considerably from year to year. Flight of 1936 largest recorded, indicating some increase. Principal movement: south, July 11 to August 22; latest, September 12. High counts, southbound, August 17, July 15, and August 12.

Actitis macularia. Spotted Sandpiper.—Extreme dates: April 20 and September

19. Principal southbound movement, July 6 to August 29. High counts, southbound, August 3, 5, and 14.

Tringa s. solitaria. Solitary Sandpiper.—Extreme dates: northbound, May 2 and 18; southbound, July 13 and September 18.

Catoptrophorus semipalmatus. Willet.—Extreme dates: spring, May 5 and June 7; fall, July 19 and October 17. Principal movement, August 10 to September 5. High counts, August 28, 11, and 28.

Totanus melanoleucus. Greater Yellow-legs.—A pronounced increase indicated. Extreme dates: northbound, February 27 and June 13; southbound, June 15 and January 17. Principal movements: northbound, April 11 to May 25; southbound, August 1 to November 1. High counts: northbound, April 28, April 11, May 8, and May 6; southbound, August 24, October 12, and October 10.

Totanus flavipes. Lesser Yellow-legs.—Extreme dates: northbound, April 23 and June 11, with a maximum of 40 on June 8, 1937; southbound, June 26 and December 1. Principal movements: northbound, April 24 to June 13; southbound, July 15 to September 27. High counts, southbound, September 5, July 29, and August 21.

Calidris c. rufus. American Knot.—Large increase in numbers over previous years. Extreme dates: northbound, February 22 and June 13; southbound, July 4 and February 7. Principal movements: northbound, May 9 to June 7; southbound, July 24 to November 1. High counts: northbound, May 25, 30, 29, and June 5; southbound, July 27, August 8, and July 31.

Erolia maritima. Purple Sandpiper.—Extreme dates, November 7 and May 23.

Erolia melanotos. Pectoral Sandpiper.—Spring records more numerous, March 19 to May 18. Extreme dates, southbound, July 17 and December 1. Principal southbound movement, July 25 to October 11. High counts, southbound, September 6, July 25, and August 28.

Erolia fuscicollis. White-rumped Sandpiper.—Extreme dates: northbound, April 27 and June 8; southbound, June 15 and November 11. Principal movements: northbound, May 9 to 30; southbound, August 28 to October 20. High counts: northbound, May 11, 10, 23, and 28; southbound, September 3, June 15, and September 4.

Erolia bairdii. Baird's Sandpiper.—No spring records. Extreme dates, August 17 and September 7. High counts, August 30 and September 5.

Erolia minutilla. Least Sandpiper.—Extreme dates: northbound, April 18 and June 13; southbound, June 15 and October 27. Principal movements: northbound, May 4 to 30; southbound, July 4 to August 4. High counts: northbound, April 20, May 30, May 16, and May 15; southbound, August 3, July 18, and July 17.

Erolia ferruginea. Curlew Sandpiper.—One seen at Beach Haven on October 3, 1937.

Erolia a. pacifica. Red-backed Sandpiper.—A large increase in numbers shown. Extreme dates, July 13 and June 15. High counts: northbound, May 11, March 8, March 6, and March 20; southbound, October 20, November 15, and October 3.

Limnodromus g. griseus and *L. g. hendersoni.* Short-billed Dowitcher.—Still increasing in numbers. Extreme dates: northbound, April 19 and June 8; southbound, June 21 and December 22. Principal movements: northbound, May 4 to 25; southbound, July 6 to August 24. High counts: northbound, May 11, 10, 16 and 15; southbound, July 27, 25 and 18.

Limnodromus scolopaceus. Long-billed Dowitcher.—First spring records, April 18 and May 2, 1937. Number of records increasing. Extreme dates, August 16 and

November 10. Principal movements, southbound, September 19 to October 27. High counts, October 13, September 27, and October 10.

Micropalama himantopus. Stilt Sandpiper.—Five spring records, all single birds, April 28 to May 16. Extreme dates, southbound, July 8 and October 20. Principal movements, July 22 to September 12. High counts, September 6, July 29, and August 12.

Ereunetes pusillus. Semipalmated Sandpiper.—Extreme dates: northbound, April 28 and June 15; southbound, June 27 and January 17. Principal movements: northbound, May 10 to June 7; southbound, July 13 to September 30. High counts: northbound, May 11, 30, 16, and June 5; southbound, August 28, July 29, and July 31.

Ereunetes mauri. Western Sandpiper.—Extreme dates: northbound, February 22 and May 30; southbound, July 4 and February 12. Principal movements: northbound, May 5 to 15; southbound, July 17 to September 26. High counts: northbound, May 11, 16, and 15; southbound, September 4, July 25, and September 19.

Tryngites subruficollis. Buff-breasted Sandpiper.—Three records, all single birds, August 30, 1935, and August 22 and 28, 1937.

Limosa fedoa. Marbled Godwit.—No spring records. Extreme dates, August 15 and January 9.

Limosa l. lapponica. Bar-tailed Godwit.—One bird seen July 18 and August 14, 1937, at Absecon.

Limosa haemastica. Hudsonian Godwit.—No spring records during this period. Extreme dates, August 23 and October 12.

Crocethia alba. Sanderling.—Large increase in numbers noted. Extreme dates, July 4 and June 15. Principal movements: northbound, May 8 to June 5; southbound, July 17 to November 24. High counts: northbound, May 11, 30, 9, and June 5; southbound, October 20, August 14, and September 4.

Phalaropus fulicarius. Red Phalarope.—Spring, one on May 4, 1935, and one on May 2, 1937. Fall, one each on September 6 and October 6, 1935, and October 4, 1936.

Steganopus tricolor. Wilson's Phalarope.—No spring records for this period. Extreme dates, southbound, August 7 and September 19.

Lobipes lobatus. Northern Phalarope.—One spring record, May 2, 1937. Extreme dates, southbound, August 14 and October 4.

TEN-YEAR SUMMARY, 1929 TO 1938

In summarizing material of this nature, one is tempted to express the noticed changes in abundance in precise mathematical terms. It must be remembered, however, that the variables involved are large, both in number and extent. For instance, it is possible to witness the main flight of a species one year and to miss it completely the next. Favorable weather and feeding conditions may be responsible for keeping large migrating flocks in an area for considerable periods in one year, and unfavorable conditions may force large flocks to pass quickly over the same area in another year. The principal migration routes for several species may vary from year to year. And finally, the data were not standardized. The total number and seasonal distribution of trips and the proportional number of trips to

each locality were not the same from year to year. For these and other less tangible reasons, numerical analyses which would be misleadingly exact have been avoided.

In the ten-year period, 41 species and subspecies of shorebirds have been recorded. Of these, 31 were observed on the northbound migration and all 41 on the southbound flight.

In order to present a picture of the relative abundance of the species observed toward the close of the ten-year period, the rankings of the commoner species for the last five years were averaged. Average rankings for the rarer species were determined by examination of the totals for numbers seen and number of times seen. The average ranking for the spring migrations for the years 1934 to 1938 follows:

ABUNDANT OR VERY COMMON

1. Semipalmated Sandpiper
2. Short-billed Dowitcher
3. Red-backed Sandpiper
4. Black-bellied Plover
5. Semipalmated Plover

COMMON OR LOCALLY ABUNDANT

6. Greater Yellow-legs
7. American Knot
8. Sanderling
9. Least Sandpiper
10. Ruddy Turnstone
11. Hudsonian Curlew

FREQUENTLY OBSERVED BUT NOT NUMEROUS

12. Killdeer
13. Piping Plover
14. Spotted Sandpiper

UNCOMMON

15. American Woodcock
16. Lesser Yellow-legs
17. White-rumped Sandpiper
18. Wilson's Snipe
19. Pectoral Sandpiper
20. Solitary Sandpiper

RARE

21. Western Sandpiper
22. Purple Sandpiper
23. Stilt Sandpiper
24. Upland Plover
25. Willet

VERY RARE

26. Long-billed Dowitcher†
27. Red Phalarope
28. Northern Phalarope
29. Wilson's Phalarope
30. Hudsonian Godwit*
31. Golden Plover*

*Not seen 1934–38.
†Probably due to failure to identify.

The average ranking for the fall migrations for the years 1933 to 1937 follows. For comparison with the years 1928 to 1934, see Urner (1935: 88).

ABUNDANT OR VERY COMMON

1. Semipalmated Sandpiper
2. Short-billed Dowitcher
3. Sanderling
4. Lesser Yellow-legs
5. Semipalmated Plover
6. Red-backed Sandpiper

COMMON OR LOCALLY ABUNDANT

7. Least Sandpiper
8. Black-bellied Plover
9. Greater Yellow-legs
10. Killdeer
11. Hudsonian Curlew
12. American Knot
13. Pectoral Sandpiper
14. Western Sandpiper
15. Ruddy Turnstone

FREQUENTLY OBSERVED BUT NOT NUMEROUS

16. Spotted Sandpiper
17. Piping Plover

UNCOMMON

18. Upland Plover
19. Stilt Sandpiper
20. Willet
21. White-rumped Sandpiper
22. Golden Plover
23. Wilson's Snipe
24. Solitary Sandpiper
25. Long-billed Dowitcher

RARE

26. Wilson's Phalarope
27. Marbled Godwit
28. Purple Sandpiper
29. Baird's Sandpiper
30. Hudsonian Godwit
31. Northern Phalarope
32. American Woodcock
33. Buff-breasted Sandpiper

VERY RARE

34. Red Phalarope
35. Wilson's Plover
36. Curlew Sandpiper
37. Bar-tailed Godwit
38. American Oystercatcher
39. Long-billed Curlew
40. American Avocet*
41. Ruff*

*Not seen 1933–37.

The great mass of data collected by the senior author has made possible some interesting contributions to our knowledge of the times of migration and relative abundance of our shorebirds. Table 10 summarizes the time of principal migration of the most numerous species. Extreme dates of occurrence, which have been overstressed in most local lists, are of little significance as they are based to a greater or less extent on "freak" occurrences. For this reason they have been omitted from the table. Anyone interested will find them entered in the annotated lists in this and in Urner's previous papers (1929, 1930, 1931, 1932, 1935).

Three figures have been prepared to show the relative abundance of several species throughout the year. These figures were plotted from data collected in the last three and one-half years of the study. Enough counts were made from late April through early October to permit averaging the counts for thirds of months in this period. For the rest of the year, monthly averages were computed. In calculating the data for the knot and the sanderling, trips to localities where no suitable habitat was present, as at Newark Meadows and Tuckerton, were omitted from the averages. All trips were averaged in the data for

the other species. It is hoped that the figures will give the observer an idea of the seasonal fluctuations in numbers occurring in these species and will provide a basis for comparing the flights of the years 1935 through 1938 with those of future years. In using these figures, however, several points should be kept in mind. First, shorebirds, like warblers, come through in waves, but the averaging of the seasonal abundance for several years will, for the most part, obliterate indications of these waves. Second, due to the irregularities in the numbers of trips to different localities, equal sampling of habitats was not

TABLE 10

TIMES OF PRINCIPAL MIGRATION OF SHOREBIRDS ON THE NEW JERSEY COAST

Species	*Spring*	*Fall*
Semipalmated Plover	May 4 to June 4	July 28 to Oct. 5
Piping Plover	—	July 4 to Sept. 9
Golden Plover	—	Sept. 5 to Oct. 2
Black-bellied Plover	May 7 to May 30	Aug. 21 to Dec. 5
Ruddy Turnstone	May 14 to June 1	July 31 to Sept. 8
Hudsonian Curlew	May 2 to May 27	July 3 to Sept. 3
Upland Plover	—	July 20 to Aug. 30
Spotted Sandpiper	—	July 6 to Sept. 3
Willet	—	Aug. 2 to Sept. 8
Greater Yellow-legs	Apr. 11 to May 25	July 30 to Nov. 1
Lesser Yellow-legs	Apr. 24 to June 13	July 12 to Oct. 1
American Knot	May 9 to June 7	July 14 to Nov. 1
Pectoral Sandpiper	—	July 23 to Oct. 11
White-rumped Sandpiper	May 7 to May 30	Aug. 28 to Oct. 20
Least Sandpiper	Apr. 29 to May 30	July 2 to Sept. 22
Red-backed Sandpiper	—	Sept. 30 to May 11
Short-billed Dowitcher	Apr. 29 to May 25	July 6 to Aug. 25
Long-billed Dowitcher	—	Sept. 6 to Oct. 27
Stilt Sandpiper	—	July 19 to Sept. 30
Semipalmated Sandpiper	May 7 to June 7	July 13 to Sept. 30
Western Sandpiper	May 5 to May 25	July 16 to Sept. 26
Sanderling	May 8 to June 5	July 12 to Nov. 24

obtained; hence, the figures are in no sense precise representations. And third, the data obtained in the winter months were not comparable in bulk to those obtained in other seasons of the year. In spite of these shortcomings, it is believed that the figures show some points of possible biological importance and may stimulate further work.

Figure 1 illustrates the seasonal abundance of three species which migrate through New Jersey. The spring migration is typically of shorter duration, and thus the number observed at the peak of this migration is larger than that seen in the fall peak.

Pitelka (MS) has found, on the basis of existing specimens, that the fall migration of young long- and short-billed dowitchers takes place over a relatively protracted period. In adults, both in spring and fall, the migration appears to occur over a briefer period. The early

fall peak in the short-billed dowitcher and semipalmated sandpiper may thus represent the main flight of adult birds, and the gradual slope of the curve subsequent to the main peak may be due to the more extended migration of the young. Further work on existing collections, and more collecting, may prove this to be the rule in many species of shorebirds.

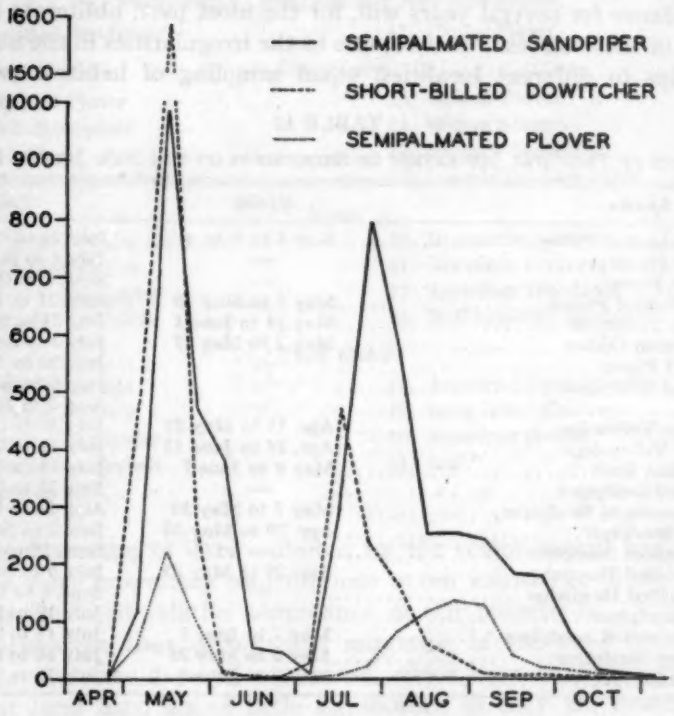

FIGURE 1. Relative abundance of semipalmated sandpiper (*Ereunetes pusillus*), semipalmated plover (*Charadrius h. semipalmatus*), and short-billed dowitcher (*Limnodromus griseus*) on the New Jersey coast. Numbers are average number seen per trip.

The curve for the least sandpiper (Fig. 2) follows the same general pattern as those shown on Figure 1. In the Hudsonian curlew, the greatest peak comes in the fall migration. A possible explanation might be that large flocks of this species do not stop in this area in the spring flight as they regularly do in the fall. The rather high point in early July is due to what is probably a "freak" record of 1000 birds on July 3, 1937. The curve for the lesser yellow-legs is typical for a species which migrates up the Mississippi Valley in the spring and

down the Atlantic coast in the fall. In the case of the greater yellow-legs, the fact that the peak is higher in the fall than in the spring may mean that some populations of this species follow a path similar to that of the lesser yellow-legs, while other populations use the Atlantic coast route exclusively. This, of course, remains to be proved. The average seasonal difference in migration between the latter two species is well shown in the graph.

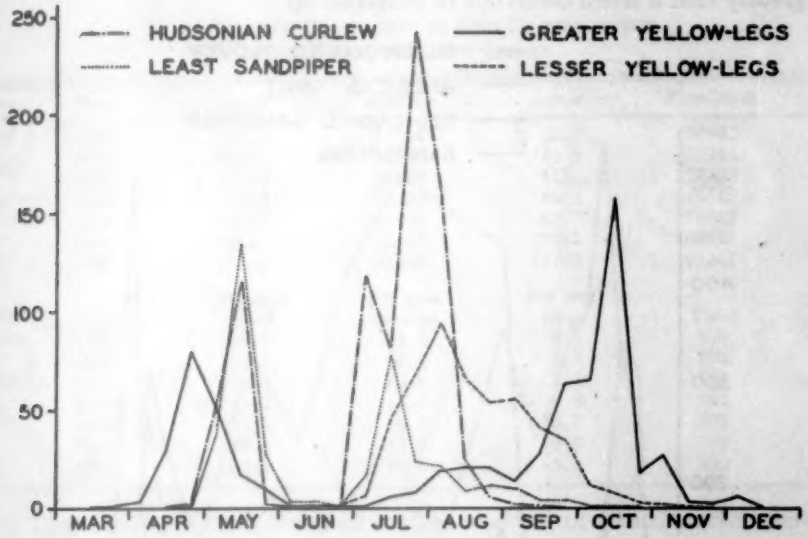

FIGURE 2. Relative abundance of Hudsonian curlew (*Numenius p. hudsonicus*), least sandpiper (*Erolia minutilla*), greater yellow-legs (*Totanus melanoleucus*) and lesser yellow-legs (*Totanus flavipes*) on the New Jersey coast. Numbers are average number seen per trip.

Figure 3 shows curves of abundance for four species which are common migrants and uncommon to common winter residents. The double peaks, for the black-bellied plover, knot, and sanderling in the fall, may be indicative of flights of adults and young birds in that sequence.

One of the striking conclusions to be drawn from the observations is that there has been a general increase of shorebirds in the course of the ten-year period. None of the common species, with the possible exception of the ruddy turnstone, could be said to have decreased in numbers. On the other hand, the most conspicuous increase was that shown by the red-backed sandpiper which increased ten- to twenty-fold in numbers between 1928 and 1938. The short-billed dowitcher, sanderling, knot and western sandpiper showed large increases, al-

though in the last species the apparent increase might be due, at least in part, to observers becoming more familiar with the species through the study period. The black-bellied plover, Hudsonian curlew, greater yellow-legs, and piping plover increased substantially, and there appeared to have been an increase in the flights of willets and upland plovers. The numbers of the remaining species either remained relatively constant throughout the period or fluctuated so greatly that a trend could not be determined.

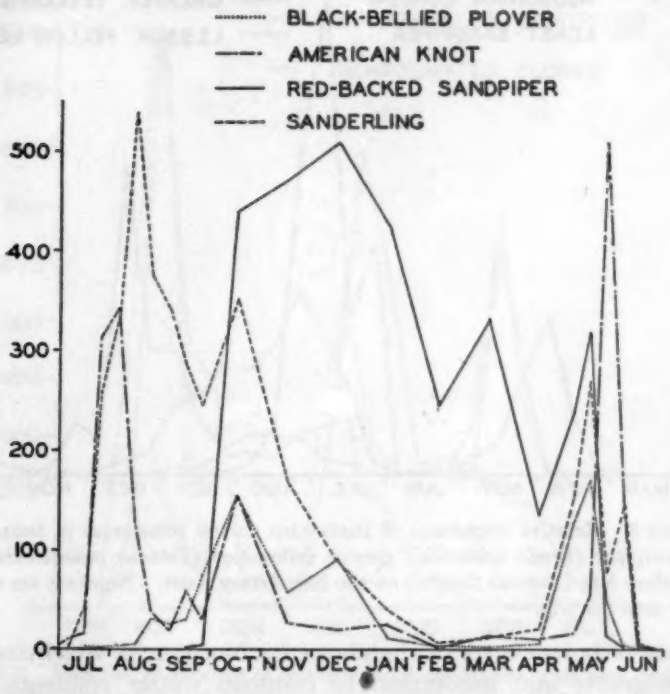

FIGURE 3. Relative abundance of black-bellied plover (*S. squatarola*), American knot (*Calidris c. rufus*), red-backed sandpiper (*Erolia a. pacifica*), and sanderling (*Crocethia alba*) on New Jersey coast. Numbers are average number seen per trip.

It is interesting to note that the increases in numbers are most noticeable in the medium-sized and large species. The accompanying table (Table 11) indicates a continuation of the trends shown by the similar table already published by Urner (1932: 474). For the sake of uniformity, this table has been prepared in the same manner as its predecessor from which the figures for the year 1928 were taken for comparison.

From this table it is obvious that the species which have increased

the most are, for the most part, those which in the past bore the brunt of the hunting pressure. Possible exceptions are the red-backed sandpiper and sanderling. However, the presence of these species in New Jersey through the winter, when the larger and more desirable game species had moved south, may have made these two species more frequent targets than they might otherwise have been.

TABLE 11

OCCURRENCE OF SHOREBIRDS BY SIZE GROUPS IN THE FALL FLIGHTS IN NEW JERSEY

Year	*Small*	*Medium*	*Large*	*Total birds*
1928	35134	12194	3074	50402
1932	35662	33243	4039	72944
1933	63331	28888	3169	95388
1934	22333	22590	4864	49787
1935	29574	38902	8207	76683
1936	42191	50635	10337	103163
1937	25444	51195	14702	91341
Year	*Per cent small*	*Per cent medium*	*Per cent large*	*Total*
1928	69.7	24.2	6.1	100
1932	48.9	45.6	5.5	100
1933	66.4	30.3	3.3	100
1934	44.8	45.4	9.8	100
1935	38.5	50.8	10.7	100
1936	40.8	49.2	10.0	100
1937	27.8	56.1	16.1	100

The senior author's series of studies was begun when, for the first time in many years, there was little or no persecution by man of shorebirds on the New Jersey coast. The increase in numbers of these birds subsequent to the cessation of shooting is gratifying. However, it cannot be hoped that these birds will ever re-attain their former numbers. The arctic and subarctic breeding grounds of the majority of the species remain essentially unchanged. The limiting factors are, therefore, those imposed by the habitats used during the migration and wintering seasons. The continual draining, filling, and dredging operations on mud flats and salt marshes in this state are constantly reducing the available habitat for shorebirds.

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Museum of Vertebrate Zoology, Berkeley 4, California, January 26, 1948.

GENERAL NOTES

An albino common loon.—On the afternoon of January 4, 1944, along the outer beach between Lighthouse Park and the northern tip of Anastasia Island which lies across Matanzas Bay from the city of St. Augustine, Florida, my wife and I sighted what we took to be a large white gull, lying belly-up just above high water mark. Upon close inspection, it proved to be a dead albino common loon, *Gavia immer*.

The bird was a true albino, with light red irides and pure white plumage. The soft parts were unpigmented, but due to decomposition the tarsi had a greenish cast. The bill was whitish in color.

An examination of the carcass showed no sign of injury. However, it was extremely emaciated, and lacked entirely the fat so typical of healthy specimens. The stomach contained only a small amount of thick, brownish mucous. The bird was a female and the ovaries were small. Measurements were as follows: culmen, 71 mm.; wing, 305; tarsus, 75. The feathers of the back and scapulars were well-rounded and, according to Bent (U. S. Nat. Mus. Bull. 107: 52, 1919), this indicated that the bird was in the first winter plumage. It is now number 159148 in the ornithological collections of the Academy of Natural Sciences of Philadelphia.

There is a second true albino common loon at the Royal Ontario Museum of Zoology in Toronto, Canada. Mr. Terence M. Shortt of that institution has very kindly supplied the following data on the bird: "Catalog number—R. O. M. Z. 30, 11, 21, 2. Shot at Go Home Bay, Georgian Bay, Ontario, in November 1930. Collector—Dr. W. P. Firth. Remarks: Earlier in the season an albino young loon was observed with normal birds at Go Home—possibly the same bird."

I can find no previous published records of albinism in *Gavia immer*.

Albinism probably occurs as frequently in loons and grebes as it does in other forms of birdlife, but it may be that the mortality rate is much higher among the albino offspring. The eyes of albino animals are notoriously weak, and food-getting may be more difficult.—Frederick A. Ulmer, Jr., *Zoological Society of Philadelphia, Philadelphia, Pennsylvania.*

Snowy egret in Wisconsin.—After a lapse of over 60 years the reappearance of the snowy egret, *Leucophoyx thula thula*, in Wisconsin has been definitely established. So completely had this species absented itself from its former range in this and adjoining states that in "Birds of Illinois and Wisconsin" (Field Mus. Nat. Hist. Publ. 131 (9): 369, 1909) Cory states, "The Snowy Heron [Egret] is of accidental occurrence in Illinois and Wisconsin"; and Kumlien and Hollister say "A rare and irregular visitor from the south during August and September," and "In August, 1866 Mr. H. L. Skavlem shot six of these birds from a flock of egrets also on Lake Koshkonong [Wisconsin]. This is the last authentic record of any numbers that we know of. Of late years very rare."

This bird's presence on a small pond in Kenosha County near the Wisconsin-Illinois state line could have easily been overlooked, since it was in company with nine immature little blue herons, *Florida caerulea*. Miss Phyllis Gorski and Mr. Carlton Buntrock of Milwaukee were attracted by this group of late summer migrants and they stopped their car and observed them intently for a considerable time. A noticeable variation was seen in the activities of one particular bird, especially when "puddling" with its feet; a subsequent check of the black toes and lower tarsus, when the bird left the water, confirmed their conviction that this individual was different.

Upon the information given, the writer accompanied Miss Gorski and Mr. Buntrock to the pond on August 29 and found the birds to be frequenting the area as noted on the previous visit. The bird was collected, proved to be a male in fair plumage and is now in the collection of the Milwaukee Public Museum.—JOHN L. DIEDRICH, *Milwaukee Public Museum, Milwaukee, Wisconsin.*

Snowy egrets in Iowa.—A snowy egret, *Leucophoyx thula thula*, was observed at Fisher's Lake north of Des Moines, Polk County, Iowa, on July 30, 1948, where it was feeding with 11 American egrets. On the following day two snowy egrets were found in the company with the American egrets. The birds were studied with a 20-power telescope and their identity definitely established. On August 4, three snowys were found in company with 25 American egrets. On August 5, three snowy egrets at Fisher's Lake and an individual on a small pond about a mile south were observed.

In checking over the records for Iowa I found that none were substantiated by specimens. A specimen of the snowy egret was, therefore, collected and found to be a male measuring 23 inches and weighing 17 ounces. This specimen has been placed in the collection of the State Historical Museum in Des Moines.—JACK W. MUSGROVE, *State Historical Museum, Des Moines, Iowa.*

Young snowy egrets with saffron in plumage.—While examining an ibis and heron rookery in Camden County, Georgia, on May 30, 1947, I was surprised to find broods of snowy egrets, *Leucophoyx thula*, with saffron in their plumage. Herbert L. Stoddard came with me the following day, and said he had never observed snowy egrets at any age with any color in their plumage. If one of a brood had saffron in its plumage, all had, with possibly one exception. I picked up one young not yet able to fly but able to scramble out of its nest and made the following notes on color: "Skin color yellowish-green shading into greenish-yellow on neck; feet light greenish-yellow; legs olive-green; bill black, with yellow at base extending to some extent into body of bill; eyes gray, iris blue; head feathers white with saffron cast; all other feathers white but with saffron tips on wing feathers particularly and, to a lesser extent, on feathers of back, tail and neck."—FREDERICK V. HEBARD, *1500 Walnut St. Bldg., Philadelphia 2, Pennsylvania.*

A bittern "pumps" from a perch in a tree.—On May 2, 1948, Mr. Paul Baker and I heard a bittern, *Botaurus lentiginosus*, "pumping" in a near by marsh. As we approached, the bird flew up out of the marsh and alighted on the limb of a red maple tree, about 30 feet above the ground. As we watched it through our glasses it "pumped" several times. The sound was clear and distinct, and the motions of the head and neck were more readily observed than is usual when a bird is half hidden by marshy vegetation.

Looking through the literature available to me, I find only one other authentic record of a bittern perching in a tree (Wright, Auk, 34: 476–477), and none of its "pumping" in such a position.—ARETAS A. SAUNDERS, *Fairfield, Connecticut.*

The eastern glossy ibis in Delaware.—On June 1, 1947, while on a trip to the marshes in the Fowler's Beach section of Delaware, a small flock of five eastern glossy ibises, *Plegadis f. falcinellus*, was flushed out of the cattails, along with a considerable number of little blue herons, black-crowned night herons, snowy egrets, and American egrets. As this was my first sight of the ibis, its identity was unknown at the time, although the fact that they were birds strange to me was quite apparent from the flight and behavior. The ibises separated from the herons and settled back

Left, HYBRID OF *Chen hyperborea* AND *Branta canadensis*. *Right,* ADULT MALE *Chen hyperborea*. JACK MILES GAME FARM, DENVER, COLORADO.

SPRING FLOCK OF *Chen hyperborea atlantica*, MARCH 29, 1945. COURTESY 4146TH AAF BASE UNIT, ATSC, DOVER ARMY AIR FIELD, DOVER, DELAWARE.

THIS DOCUMENT IS THE PROPERTY OF THE UNITED STATES GOVERNMENT

into the cattails just a short distance away. I approached the birds and, as they flew, shot and killed one. The other four circled the marsh and again settled down. As they flushed again, I collected another. The remaining three circled out of sight but soon came back and again settled into the marsh.

I again approached the ibises, this time very carefully, and got within 50 feet of them. They were standing along the edge of a small pond, with their decurved bills lying along their breasts. After a short time they began feeding in the pond, with very deliberate movements. After feeding for about 20 minutes they flew up and circled out of sight. In approximately half an hour they returned and dropped into the cattails a short distance away. This time I approached to within 30 feet and watched them for about an hour as they fed and preened. As I wanted to look over more of the marsh I rose, flushing the ibises. They again circled out of sight and returned to the same general area. The last I saw of them they were again dropping into the cattails.

Examination of the two specimens taken showed that one was an adult male and one was an adult female. The gonads of each were in breeding condition, those of the male being much enlarged, and those of the female containing eggs as large as the end of an ordinary pencil. While watching the living birds from a very close range, a light line was seen extending around the base of the feathers. In the living bird this appeared white, but in the birds collected it was seen that this line was of a greenish-white and was a line in the bare skin at the base of the bill. At a little distance in poor light, or at a glance, it would be very easy to confuse this line with the white feathers around the base of the bill of the white-faced glossy ibis, *Plegadis mexicana*. There are few ornithological works that mention this line.—JOHN H. BUCKALEW, *Chincoteague National Wildlife Refuge, Chincoteague, Virginia.*

An abnormality in a Canada goose.—On April 1, 1948, a Canada goose, *Branta c. canadensis*, was found by laborers on the Tuckahoe Public Shooting Grounds, Tuckahoe, New Jersey. The bird was emaciated and unable to fly. An autopsy was performed by Mr. C. B. Hudson, Department of Poultry, Rutgers University, New Brunswick, New Jersey. The lower esophagus and proventriculus were severely impacted with a mixture of sand and vegetable material, mostly leaves which resembled *Spartina alterniflora*. A blood smear and a macroscopic examination of the intestinal tract did not reveal any parasites. Impaction of the upper digestive tract is a rather common occurrence in chickens and domestic turkeys.—EDWARD L. KOZICKY, *New Jersey Division of Fish and Game, Trenton 7, New Jersey.*

Hybrid of snow and Canada goose.—An interesting example of hybridism between a male lesser snow goose, *Chen hyperborea hyperborea*, and a female Canada goose, *Branta canadensis*, occurred on the game farm of Jack Miles of Denver, Colorado. He has a small band of pinioned Canada geese and one crippled, male snow goose. In 1942, and the following spring, the snow goose followed a Canada goose and attempted to mate, apparently without success. His attentions continued in the next two years, and eggs were laid both seasons, but they did not hatch. In 1946, four eggs were laid and in due time three young appeared, two of which were raised. These two young, a trifle larger than the snow goose, have nearly white heads, a flecking of white upon the neck, and their underparts are whiter than in Canada geese (Plate 3). — ALFRED M. BAILEY, *Denver Museum of Natural History, Denver, Colorado.*

Observations on greater snow geese in the Delaware Bay Area.—One of the major resting and feeding areas used by greater snow geese, *Chen hyperborea atlantica*,

on their migrations is the extensive marshy areas lying along both sides of Delaware Bay at Fortesque, New Jersey, and the Bombay Hook National Wildlife Refuge in Delaware. Data recorded at the Bombay Hook Refuge show that weather conditions are primarily responsible for the times of appearance and duration of stay in this area. The geese have been noted to arrive as early as September and as late as November. They remain until the marsh freezes, which may occur from November to January. Spring data include arrival dates in February and March, with the geese usually remaining until April.

Through the courtesy of Colonel Donald B. Diehl, Commanding Officer of the 4146 Base Unit, AMC, USAAF, located at the Dover Air Base in Delaware, both the fall and spring flights were photographed from the air. The area containing the geese was first flown over and the geese herded into a flock. Then the flock was chased out into the bay to provide a dark background for the photographs. A series of pictures of each flock was taken at an altitude of about 500 feet and the best photograph enlarged to 20 by 24 inches so that *each goose* could be counted. The fall flock contained 2,659 individuals, and 13,494 were in the spring flock.

Plate 4 is the photograph taken of the spring flock on March 29, 1945. It points out the usefulness of aerial photography as an aid in censusing the various forms of wildlife, particularly waterfowl.

Another interesting fact which was brought out by the photograph was the wide divergence of opinions expressed as to the total number of birds contained in the flock. Shortly after the photograph was "counted," several visitors to the Bombay Hook Refuge were shown the photograph and asked to estimate the total number of birds. The results were so at variance that an effort was made to gather further data to determine how much reliance could be placed on estimates made of large flocks of waterfowl. Through the courtesy of Colonel Diehl, several large photographs were made available to interested organizations. In addition, all visitors to the Refuge and Army personnel at the Air Base were asked to make estimates. The averages and ranges of the estimates varied directly with the experience of the observer. Estimates of 91 laymen varied from 1,000 to 1,000,000, and the average was out of all proportion to the actual figure. The estimates of 52 ornithologists varied from 3,000 to 28,000 with an average of 9,000.

Another interesting point was brought out by two of the photographs of the fall flock. The first photograph was taken as the flock rose from the feeding grounds on the refuge and flew in a long line toward the bay. The second was taken as the flock settled on the bay in a compact group. Invariably, observers overestimated the number in the first photograph and underestimated on the second.

Mr. Charles L. Slaughter, maintenance man at the Refuge, assisted materially in the counting work. Master Sergeant Robert Livingston was the photographer on all flights. William Burchard and Clifford Hagerman of the Photographic Laboratory of the 4146 Base Unit assisted in technical details.—George P. Spinner, *Bombay Hook National Wildlife Refuge, Smyrna, Delaware.*

Notes on the sexual behavior of the baldpate.—On May 28, 1948, at 7:45 a. m. in Ashbridges Bay in Toronto a male baldpate, *Mareca americana*, dropped into a group of two females and one other male on the water and started to chase one of the females. Both flew up, the male behind. He caught her tail feathers with his beak and held them. They dropped to the water, the male on top and still holding the tail feathers. The female sank into the water until only her head showed. They copulated. As far as I know, this behavior has not been previously recorded on the

part of the baldpate.—JESSIE HAMBLETON, *182 Eglinton Avenue East, Toronto, Canada.*

The American pintail in the Province of Quebec.—In June, 1945, the writer flushed an unknown female duck at Point St. Denis. Judging by her strange behavior she must have been brooding. Some time after, as I waited in the woods, she came back. I managed to see where she landed and found a nest with six or eight ducklings, one of which was captured and sent to Mr. W. E. Godfrey of the National Museum of Ottawa. It was identified as the pintail duck, *Anas acuta*. I think this is the second authentic record of breeding of the species in the Province of Quebec.—ABBÉ A. TANGUAY, *St. Ann de la Pocatiere, Province of Quebec, Canada.*

European teal in coastal South Carolina.—On November 28, 1947, while conducting the Audubon Wildlife Tour to Bull's Island, South Carolina, the writer with a group of eight observers, saw a well-plumaged male *Anas crecca* in House Pond. The bird was about 50 yards distant, in excellent light, and in company with four or five drakes of *Anas carolinense*. Even the observers unfamiliar with ducks could readily see the differences between this bird and the accompanying teal. The lack of the white bar in front of the wings and the presence of the horizontal white stripe on the scapulars was perfectly apparent and commented on by all of them.

The occurrence of *A. crecca* in South Carolina is, of course, purely accidental. One specimen was secured (February 13, 1930), at the Santee Gun Club, Charleston County, by Richard Bishop. This was recorded by Stone (Auk, 51: 227, 1934) and constituted the first record for this region. In December, 1946, the writer saw one of these teal on Bull's Island practically in the same place as recorded above. There have been, therefore, three records for this accidental wanderer in South Carolina, two of them sight records by this writer. The Bull's Island bird was still present on December 5, but in another pond (Moccasin).—ALEXANDER SPRUNT, JR., *The Crescent, Charleston 50, South Carolina.*

Breeding of the shoveler in New Brunswick.—During the course of the summer of 1948, I was able to follow the activities of a pair of shovelers, *Spatula clypeata*, which nested on the Midgic Marsh, in Westmorland County, New Brunswick, near the Nova Scotia boundary.

I first saw this pair on May 4 and continued to observe them during visits in May and the first half of June. On June 20, I flushed the female from her nest which was built on the bank of a small drainage ditch. The poorly concealed nest was located about three feet from the edge of a small, shallow pond and about six inches above the level of the water. It contained eight eggs and, judging by the behavior of the female, I would say that incubation was well under way.

On July 12, I visited the marsh after an absence of about two weeks. The nest was empty and there was not a sign of either of the shovelers. Previously, I had always observed both birds within 500 yards of the nest site.

It was not until August 7 that I again saw any sign of the shovelers. In the early evening I was observing a group of waterfowl from concealment in the cattails surrounding a pond of about five acres. This pond was approximately one mile from the nest described above. I saw a female shoveler duck with a brood of nine swimming towards me. They approached to within about six feet and, stepping out of my hiding place, I managed to retrieve four of the ducklings from the bottom of the pond where they had sought concealment. They were only a few days old and, although they bore no pinfeathers, their bills had begun to take on the shape

characteristic of the species. As they were too small to band I returned them to the water after a brief examination.

I am quite certain that there was only one pair of shovelers in the area. Therefore, this brood must have been the result of a renesting attempt. It is interesting to note that there was at least one more egg laid during the renesting than in the first attempt.

My last observation of the brood, on August 25, showed them to be well-feathered and about half the size of the female. By this date their number had dwindled to six.—G. F. Boyer, *R. R. No. 1, West Sackville, New Brunswick.*

Recent records of the ring-necked duck.—On August 3, 1947, a juvenile female ring-necked duck, *Aythya collaris*, almost ready to fly was trapped and banded by Jack Jedlicka at the Orland Wildlife Refuge, eight miles southwest of the Chicago city limits. His father who has previously banded ducks here for the Illinois Natural History Survey and he identified the bird.

The evidence points toward breeding in northern Illinois. This is further strengthened by observations of the author in 1940 when on June 26 and on July 3 and 5 he saw several males and a female of this species on Longjohn Slough, five miles north of the refuge near the town of Willow Springs, Illinois. It was not determined if these were breeding birds, but the dates are far past the spring migration period, as most individuals have passed through by the first week in May.

A review of the literature indicates that the southern breeding range of this species formerly extended into the lake region of northeastern Illinois, but it has not been known to nest there for many years. However, at present the ring-necked duck appears to be a rare breeder in this area.

Another interesting record of the ring-necked duck is that of an adult male banded at the refuge on March 23, 1945, and shot on October 27, 1945, at Mingan, Quebec, north of Anticosti Island. Correspondence with Dr. Oliver Hewitt of the Dominion Wildlife Service and Mr. Howard Mendall of the Maine Cooperative Wildlife Research Unit reveals that this apparently constitutes the most northeasterly record for the species.—Paul F. Springer, *Illinois Natural History Survey Laboratory, Havana, Illinois.*

Greater scaup eating frogs.—On April 12, 1948, four greater scaup, *Aythya marila*, were observed eating frogs on a roadside pond near Ortonville, Minnesota. The ducks diving near the shore and perhaps 30 yards from the road had swallowed several large objects before we recognized that the objects were frogs. Seven frogs were then eaten within the next few minutes. Apparently they were leopard frogs, *Rana pipiens*, with a body length of about two inches. I believe they were in the dormant condition as yet. Near the middle of the pond, 100 yards from us, were three more greater scaup and ten lesser scaup, *Aythya affinis*, which fed on vegetable material.—William H. Longley, *Saint Paul, Minnesota.*

Rallus philippensis on Mindoro, Philippine Islands.—Mr. J. Frank Cassel has generously donated a small collection of birds from New Guinea and the Philippines to Cornell University. Among these specimens is a skin of *Rallus philippensis* from San José, Mindoro, P. I. This specimen apparently represents the first record of the banded rail from any Philippine island other than Luzon or Bataan (Delacour and Mayr, Birds of the Philippines, 1946: 62).

The specimen is a subadult female taken April 1, 1945. It was captured by William K. Clark in a rat trap near a garbage pit in an old sugar-field which had

reverted to grassland. The ovary is described on the original label as "undeveloped."

Mr. Herbert Deignan of the United States National Museum kindly checked the Mindoro specimen against the series in that institution and has given me permission to quote from his notes. Mr. Deignan states, "The Mindoro bird has been compared with four specimens of *philippensis* from Luzon, nine of *chandleri* from Celebes, and eight of *pelewensis* from the Palau Islands. It appears that *chandleri* and *pelewensis*, compared with each other, are pretty good races, especially in series, but that *philippensis*, the first-named form, is variably intermediate between them . . .

"The Mindoro bird, when placed in the series of *chandleri*, cannot be picked out, without reference to the label. However, the same thing is true of a Luzon specimen, and this Luzon bird agrees in every way with the one from Mindoro. Under the circumstances, one must call the latter *philippensis*.

"It is regrettable that the oldest name for the species as a whole was bestowed upon the unstable Philippine population."

Like most rails, *Rallus philippensis* is secretive in its habits. It may, therefore, be present on other islands of the Philippines where it is as yet undetected.

The Mindoro specimen is now number 21385 in the Louis Agassiz Fuertes Memorial Collection at Cornell University.—KENNETH C. PARKES, *Laboratory of Ornithology, Cornell University, Ithaca, New York.*

Southernmost nesting of the Florida gallinule in the United States.—Although the Florida gallinule, *Gallinula chloropus cachinnans*, is known to breed through Tropical America and South America to the Argentine, it apparently has not been reported in this country south of Cape Sable, Florida. The writer has worked for many years in the Florida Keys but has no knowledge of a nest of this species ever having been found there. No mention of such is made in either Florida Bird-Life (Howell, 1932) or Life Histories of North American Marsh Birds (Bent, 1926).

On June 17, 1948, while making a population survey of the sooty and noddy tern colony on Bush Key, Dry Tortugas, the writer happened to be on the edge of a smaller pond on that key. On the north shoreline, about midway of the pond, he stopped by a bay cedar bush, *Suriana*, to make some notes. He happened to look down, and there, directly at his feet, was a well-made nest. It was about one foot from the ground, attached to stems of mixed growth of bay cedar and high glasswort, *Salicornia*, and measured about ten inches across the top. It was a shallow, though noticeably depressed, platform of dried grasses and weeds, a type of nest utterly unlike any to be expected in these keys. Looking about, and under it, several small feathers were to be seen, many of them in the nest itself, exposed and partially exposed amid the grass material. Some dozen of these were removed. The nest was otherwise empty. These feathers were from a half inch to an inch long, downy and of a dark grayish shade. These were forwarded to Dr. Alexander Wetmore with the request that he name them. He replied that they were those of *Gallinula chloropus cachinnans*. The writer has worked at Tortugas for four consecutive seasons (June) with several trips prior to 1945, and no such nest has ever been seen on any of the keys comprising that group. It certainly must constitute the most southerly nesting for this species in its range in the United States.

No mention of the Tortugas is made in connection with this species by Howell (Florida Bird-Life) though he does mention the locality in regard to the purple gallinule, *Porphyrula martinica*. However, Paul Bartsch gives a record for it, as occurring on Tortugas in 1890, on authority of W. E. D. Scott (Bird Rookeries of

the Tortugas, Smithsonian Report, 1917). Scott's observations were recorded (Auk, 7: 301).

It may be of further interest that on Long Key, the writer's son picked up on June 16 a pair of wings attached to an almost complete sternum and ribs. These were identified by the writer, and corroborated by Dr. Wetmore, as those of a purple gallinule.—ALEXANDER SPRUNT, JR., *The Crescent, Charleston 50, South Carolina.*

The southernmost nesting of the killdeer.—On June 1, 1948, Glenn T. Chandler found a nest and four eggs of the killdeer, *Charadrius vociferus*, at "Nigger Duck," three miles west of the mouth of the Kissimmee River, Lake Okeechobee, Glades County, Florida. On June 20, the writer went to the spot with Warden Chandler and saw the bird on the eggs. As far as can be ascertained, this is the southernmost point at which this species has been found breeding in this country. Old-timers in the Lake Okeechobee-Kissimmee Prairie region, who have spent their lives in the area, stated that they had never seen or heard of the "killdee" except in winter.

Donald Nicholson (MS) found killdeer eggs hatching at the mouth of the Kissimmee River on June 7, 1943. The most southerly record next to this is that by Howell (Florida Bird-Life, 1932: 221) at Lake Istokpoga, some 20 miles to the northward. The breeding range is now extended at least to Lake Okeechobee.—ALEXANDER SPRUNT, JR., *The Crescent, Charleston 50, South Carolina.*

Long-billed curlew breeding in Colorado.—Peters (Check-list of Birds of World, 2: 263, 1934) reports that the long-billed curlew, *Numenius a. americanus* Bechstein, "now breeds only in southern Idaho, eastern Nevada and Utah; formerly bred east to Wisconsin and Illinois." It seems appropriate, therefore, to record our finding breeding birds and downy young just out of the nest along Two Buttes Creek, 14 miles north of Springfield, Baca County, Colorado, in early June, 1948. At this locality a dozen or so pairs were nesting on grassy flood plains along the creek. Downy young were handled and photographed by members of our group on June 10.

Birds in breeding condition were also collected three miles south of Campo, Colorado, on June 8. This is some 40 miles south of Two Buttes Creek. The birds were paired and behaved as if they were nesting.

In 1947, several curlews were observed on grassy flats three miles southeast of Texline, Dallam County, Texas, on June 2. A male collected there had large testes in breeding condition. It is quite likely that these birds were nesting in the vicinity.

These records indicate that some of the former breeding range, at least, is being reoccupied. Also, they suggest that the numbers of curlews are on the upgrade.

Measurements in millimeters of two males were: culmen, 137 and 162; wing, 265 and 265; of two females: culmen, 200 and 216; wing 285 and 293. Measurements of the females are well above the maximum for *N. a. parvus* and within the range of variation for *N. a. americanus*.—WILLIAM B. DAVIS, *Department of Wildlife Management, College Station, Texas.*

Status of the upland plover in Lancaster County, Pennsylvania.—Lancaster County, perhaps more so than any other parts of Pennsylvania that are hilly and still quite generally wooded, today affords conditions well-suited to *Bartramia longicauda*. Originally of the midwest plains, the species probably came into this part of eastern North America only after this heavily timbered region had been cleared into broad farmlands, for the bird's adopted habitat must be sufficiently prairie-like.

Within Pennsylvania these conditions are best fulfilled in localized parts of the Piedmont Plateau, that highly agricultural, fairly low region southeast of the Kittatiny or Blue Mountain range, against the Mason and Dixon Line and the Delaware River. From a fair estimate, based on early agricultural developments of Lancaster County, though without authentic records, the upland plover probably came into this region about 1800. About one-third of the bird's annual cycle is spent on its breeding grounds; in Lancaster County this is from April 15 to the last week in August. November to March it is on its winter range, the vast pampas of Argentina into Uruguay. The last third is along its still not entirely known migration route—two months of the fall in passing south mainly through the West Indies and about two months of the early spring in returning north, chiefly through Texas and Oklahoma, to its breeding range in the northern parts of the United States and Canada. The round trip is more than 14,000 miles. Following my plan, which I started in 1921, to estimate the status of the upland plover in Lancaster County, I took my tenth census on August 6, 1947. Four areas were selected as typical breeding and feeding grounds of the upland plover in 1921, on the basis of my prior experiences as a hunter. These were covered, as usual, by a party of competent observers who counted the birds seen. These widely separated tracts, in central and northern Lancaster County, are as follows: A, two square miles in Penn-Warwick townships; B, two square miles in Manheim Township, including the Lancaster Municipal Airport; C, one square mile in Warwick Township; D, two square miles in Elizabeth–Clay townships. The complete census report, to date, is as follows:

Tract	*A*	*B*	*C*	*D*	*Total*
1921 (Aug. 4)	12	3	3	3	21
1922 (Aug. 3)	8	9	1	4	22
1923 (Aug. 9)	23	35	1	15	74
1925 (Aug. 8)	1	3	0	1	5
1936 (Aug. 4)	5	22	4	11	42
1937 (Aug. 4)	11	28	1	17	57
1939 (Aug. 3)	14	75	0	5	94
1941 (Aug. 4)	94	65	0	2	161
1945 (Aug. 8)	5	28	12	2	47
1947 (Aug. 6)	23	82	1	2	108

The count of 1945 I do not consider normal. That season, hay-making and harvest were so delayed by nearly continuous wet weather that the first week in August found most of the grass and wheatfields still uncut and full of weeds. Feeding conditions being unfavorable, I believe many of the plover left the region earlier than usual. A notable feature of the census, in recent years, has been the increase of plover on tract B, the Lancaster Municipal Airport. On this broad, level land, where there is only grass, the bird has found conditions similar to those of the midwest prairies. Between one and two dozen pairs breed there now. Still wary of man, rising and descending planes have become an unnoticed part of their lives.

Protection in the United States, with little doubt, has saved this picturesque dryland sandpiper from the extinction suffered by its relative, the Eskimo curlew, *Numenius borealis*. For, protected in the United States since 1914 and no longer killed there to any extent, the upland plover is still a prized game bird over the greater part of its range after it leaves the United States. Richard H. Pough of the National Audubon Society, a few years ago, found great numbers of upland plover being shot in Barbados during the fall. Alexander Wetmore of the United States National Museum reported, after a visit to South America in 1926, that there were many market gunners in Argentina and Uruguay, that the game-laws there were

loose and not enforced, and that the upland plover was one of the favorite foods served in many restaurants. It had in fact replaced the Eskimo curlew as a table delicacy. A recent letter from Dr. Wetmore indicates that he knows of no change in these conditions.

Assuming that the census in Lancaster County properly represents conditions in its extensive breeding range, which I think it does, the general numerical status of the upland plover seems to be stabilized today. While there has been a notable increase since 1914, the rate of production in the northern zone now seems to be balanced by the rate of destruction in the southern zone. Possible increase is dependent upon improvement and enforcement of the game laws in countries along the migration route, and in Argentina and Uruguay. It can scarcely be hoped that the numbers will ever return to those of 1906. On July 16 of that year, according to my diary of field-sports, there were 250 to 300 plovers on tract D alone.

I was assisted in 1947 by Leo A. Luttringer, Jr., Frank T. Thurlow, Barton L. Sharp, Russell Markert, George H. Pennypacker, Charles H. Regennas, Jr., Donald Ruhl and John D. Kendig.—HERBERT H. BECK, *Franklin and Marshall College, Lancaster, Pennsylvania.*

Flock of northern phalaropes at Daytona Beach, Florida.—On the night of September 2, 1948, people attending a baseball game on City Island, in the Halifax River about one mile west of the Atlantic Ocean, saw a flock of 50 to 100 birds fly out of the darkness and dash into the brilliant lights which illuminate the field. This continued for several minutes, in the course of which some 20 birds fell to the ground. Observers were uncertain whether the same flock was circling about, to appear and re-appear, or whether several flocks came in quick succession. Two of the birds were picked up alive and brought to me the next day for identification; they were northern phalaropes, *Lobipes lobatus*. The boys who picked up these birds reported that about 20 more were lying on the ground. I visited the ball park the next afternoon and found eight mangled bodies. One of the captured birds died during the night; the other was released in the Halifax River. This would seem to be the first record for a flock of northern phalaropes in Florida, and the third record for the species in this state.—R. J. LONGSTREET, *Daytona Beach, Florida.*

Glaucous gull in South Carolina.—On November 22, 1947, on the Cooper River waterfront of Charleston, S. C., I saw a gull which from its white wings and large size, I took to be the glaucous, *Larus hyperboreus*. Two days later the bird was secured by Mr. E. B. Chamberlain and was found to be *hyperboreus*.

It is the first specimen to be taken in South Carolina. Measurements are as follows: wing, 462 mm.; tail, 186 mm.; exposed culmen, 56 mm. (the tip of the bill was shot off); height of bill, 20 mm.; and tarsus, 65 mm. Previously, the only instance of a "white-winged" gull being seen on the South Carolina coast was the report by W. W. Humphreys of a bird in November, 1943, near the same place. Efforts to secure it failed. In February, 1931, Ivan R. Tomkins secured a specimen of the glaucous gull at the Savannah River entrance, on the Georgia side.—ALEXANDER SPRUNT, IV, *Davidson, N. C.*

"Puddling"—A method of feeding by herring gulls.—On October 23, 1947, herring gulls, *Larus argentatus*, were observed feeding in shallow tide pools on the sandy beach at Belliveau Cove, St. Mary Bay, Nova Scotia, in a fashion that was new to the writer. The birds stood in water one-fourth to three-fourths of an inch deep and worked their feet up and down with a pumping motion for about 30 seconds

until they stood "knee-deep" in a water-sand mixture. Meanwhile, sand washed forward under the webbed feet and built up a raised arc just below the breast. This produced a nearly saucer-shaped depression in the sand approximately nine inches across and two inches deep, the deepest part being where the gull's "heels" rested.

After pumping, the gull stepped back onto firm ground, waited a few seconds, presumably for the water to clear, and then picked out certain items from the assortment which had been washed to the surface of the arc in front of it.

The gulls seldom worked close together. In some cases they wandered about making widely-spaced single "puddles," presumably prospecting for a good feeding area. In other cases, possibly where "pickings" were good, instead of making individual puddles they extended those already made. This seemed to be done by slowly edging backwards during the pumping. In this fashion sometimes six or eight puddles were created and successively obliterated, except for the last which remained to mark the site of the working. The position of each of the earlier ones was usually indicated by a semicircular arc of sand raised about one-half inch above the general level of the flat. After about five minutes' effort such a working was in several instances 20 to 24 inches long and the soil in it churned to the consistency of gruel to a depth of three and one-half inches. Previously, the writer had often encountered such workings during examinations of clam flats in other parts of Nova Scotia but did not know what they were.

The tide flat at Belliveau Cove is sandy throughout and when fully exposed is one mile long and one-half mile wide. About half its area below half-tide mark is covered by tide pools with an average area of four square yards and seldom deeper than two inches. That day the cove was occupied by 1000 to 1500 gulls, and puddling was very popular. Half the pools had puddles in them, although very few had more than one. They were seldom "singles," most had been extended until the total length of the working measured 18 inches.

The puddles were easy to recognize, not only because of their characteristic saucer shape but also because the sub-soil brought to the surface by the puddling was darker than the regular surface sand. Presumably all these features would be obliterated by the rising tide, except on very calm days.

Exactly what the gulls were eating could not be determined because they would not permit close inspection, and the writer had no gun to collect specimens. The beach is heavily populated with small soft-shelled clams, *Mya*, and clam drills, *Polinices*, and both these live in the upper few inches of sand during the day. Remnants of both these mollusks were found in regurgitated gull "pellets" collected from the beach on several occasions during the past summer. Obviously, the birds had access to food from below the surface—probably through the device of puddling just described.

The only record of similar behavior of gulls that has come to the writer's attention is that of Witherby *et al* (Handbook of Brit. Birds, 5: 86, 1941). In discussing the herring gull, they state that it exhibits "feeding habits common to several other species—tramping with both feet on wet sand of shore to bring up worms (also sometimes on turf, especially after rain: A. F. J. Portielje)." No detailed observations are given.

Puddling may be regarded as analogous with scratching which is so significant in the feeding of some of the gallinaceous species.—J. C. Medcof, *Atlantic Biological Station, St. Andrews, New Brunswick, Canada.*

Black-headed gull in Florida.—On March 2, 1948, while crossing Tampa Bay, Florida, on the St. Petersburg ferry we came upon a large concentration of gulls

feeding on some floating rubbish. Among the usual ring-billed gulls (*Larus delawarensis*), herring gulls (*Larus argentatus smithsonianus*), laughing gulls (*Larus atricilla*) and Bonaparte's gulls (*Larus philadelphia*) was a fine specimen of a European black-headed gull (*Larus ridibundus ridibundus*). Even though this is probably the first report of this Old World species for the state of Florida, I submit the observation with confidence; I have seen thousands of these birds in other parts of the world and had an excellent opportunity to observe all the necessary field marks on this Florida vagrant.—ALLAN D. CRUICKSHANK, *Rye, New York.*

Sooty tern and northern horned lark in South Carolina.—There was brought to me on September 25, 1947, an immature sooty tern, *Sterna fuscata fuscata*. It was taken alive by a young man at the Great Pee Dee River, 10 miles east of Florence, Florence County, South Carolina. Evidently this bird was blown in from the south by the tropical storm that struck the coast of South Carolina two days previously. Two weeks later this bird had become quite tame and ate fish and raw shrimp from our hands.

On January 26, 1946, I collected two female northern horned larks, *Eremophila alpestris alpestris*, from a flock of American pipits, *Anthus spinoletta rubescens*, feeding in an oat field on the Revel plantation about two miles west of Florence, Florence County. A male northern horned lark was taken on January 29, 1946.

Identification of the tern and horned larks was made by Alexander Sprunt, Jr. of the National Audubon Society and E. B. Chamberlain of the Charleston Museum.—H. L. HARLLEE, *1301 West Palmetto St., Florence, South Carolina.*

Winter record of ivory gulls, St. Jean Port Joli, Quebec.—The College Museum received, in the flesh, three adult ivory gulls, *Pagophila eburnea;* the birds were captured on March 3 and 4, 1947, at St. Jean Port Joli, Quebec. Two of the birds are now in the Museum's collection.—REV. RENÉ TANGUAY, *Director, Museum Ste. Anne de la Pocatiere, Province of Quebec, Canada.*

Status of roseate tern as a breeding species in southern United States.—As is well known, the distribution of breeding colonies of *Sterna d. dougallii* on the Atlantic seaboard shows remarkable gaps and is very highly localized. Particularly is this true in the southern states. If one reads the ranges given in "state" bird books of this region, he would get a completely erroneous idea. For instance, in the "Birds of North Carolina" (Pearson & Brimleys, 1942: 176) this statement appears, . . . "breeds from Nova Scotia to Virginia." Naturally, the assumption of the reader would be that it does not breed south of Virginia. In "Florida Bird-life" (Howell, 1932: 264) the range is given as "breeding . . . on the Atlantic coast of America from Sable Island, Nova Scotia south to Virginia." It is true that Howell, in the body of his text on the species, mentions the colony at Dry Tortugas, but *not* in his discussion of range. In "Birds of Georgia" (Odum, Stoddard, Tomkins *et al.* 1945: 43) there is listed but one occurrence in the state, this a late fall specimen. In "Birds of Alabama" (Howell, 1924) the species is not included in any way. In "The Bird Life of the Gulf Coast Region of Mississippi" (Burleigh, 1944) the species is likewise omitted entirely; there are no records. In "Bird Life of Louisiana" (Oberholser, 1938: 295) there is a record of a single bird, the only one for the state. Peterson's revised "Field Guide" (1947) gives the best indication of range, as he states that the species breeds "in widely separated localities from Nova Scotia to Texas." None of these authorities mention the Dry Tortugas in their "range" when, as a matter of fact, it is the *only* locality between Virginia and Texas where

this tern does breed! Indeed, one could say that it is the only locality where one can be anything like sure of *seeing* the bird, except as a very brief migrant, anywhere southward from Virginia. There are three records for North Carolina, one actual specimen from South Carolina, one from Georgia, none from the east coast of Florida, none from Alabama, none from Mississippi, and one from Louisiana.

Audubon, in his day, found nesting roseates on "small detached rocky islands" in the Florida Keys. No specific key is mentioned. Neither H. K. Job, who photographed at Tortugas in 1903, nor J. B. Watson, whose magnificent work with the sooties and noddies is a classic, appears to have paid any attention to the roseate colony, if it was then current. Paul Bartsch did, recording about 100 pairs nesting in 1917. Nothing else appeared in any detail regarding these birds until the Florida Audubon Society began making population studies of the sooty and noddy colonies in 1936. Roseates were noted by observers of that group, and a record was kept. The activities of that group may be summed up by listing the annual counts.

1936, 400 birds present, the assumption being 200 nesting pairs.
1937, none.
1938, 314 birds.
1939, 80 birds.
1940, 20 birds.
1941, none.

No observations were made during the war years of 1942-43-44. In 1945, the writer began his systematic population studies at Tortugas, and the record is better. It is listed below.

1945, 85 nests; bird population, 170.
1946, not a single bird present!
1947, 142 nests; birds 284.
1948, 225 nests; birds 450.

No explanation presents itself for the fluctuation from zero to more than 200 nesting pairs in different years. Conditions amid which these terns breed at Tortugas vary not at all; they use keys without vegetation, and heavy storms seldom occur there during the nesting season. Natural predation cannot be a factor, for even the hermit crabs and sand crabs, so abundant on the nesting grounds of the sooty tern, are few on the barren islets used by the roseates. Predation by frigate birds is probably nil; and human interference is certainly non-existent.—ALEXANDER SPRUNT, JR., *The Crescent. Charleston 50, South Carolina.*

Wilson's warbler in Maryland in late December.—On December 22, 1947, while participating in a Christmas Bird Count on the eastern shore of Maryland, I observed a Wilson's warbler (*Wilsonia pusilla*) feeding along a sunny margin of a woods near the Pocomoke River, three miles north of Snow Hill. It was with a flock of myrtle warblers (*Dendroica coronata*), white-throated sparrows (*Zonotrichia albicollis*), Carolina chickadees (*Parus carolinensis*), and several other species. My attention was first attracted to the Wilson's warbler by the distinctive call note which it repeated about once a minute. The bird was actively feeding among the dead leaves on a group of young oak trees. The bird was collected and proved to be a female. The skin was preserved for the collection of the Fish and Wildlife Service. The stomach was full, and the contents were identified by Robert T. Mitchell as: fragments of *Araneida*, 80 per cent; *Coleoptera*, 10 per cent; *Hymenoptera*, 10 per cent.

Subspecific identification as the eastern race *pusilla* was made by Dr. John W. Aldrich. This appears to be the first winter record for Wilson's warbler north of the

gulf states. Two previous winter occurrences of *Wilsonia pusilla* in the eastern United States have been published as follows: Lowery (Additions to the List of Birds of Louisiana, Univ. of Kans. Publ., 1: 177–192, 1947) has recorded a female *Wilsonia p. pusilla* collected on December 20, 1944, at Baton Rouge, Louisiana; and Stevenson (Auk, 64: 468–469, 1947) has described a sight observation of this species near Tallahassee, Florida, on January 1, 1947.—CHANDLER S. ROBBINS, *United States Fish and Wildlife Service, Patuxent Research Refuge, Laurel, Maryland.*

The Guianan meadowlark in Surinam, Dutch Guiana.—The range of the Guianan meadowlark (*Sturnella magna praticola*) is given by Hellmayr (Cat. Birds Americas, 10: 218, 1937) as northeastern and southern Venezuela, British Guiana and northeastern Brazil. It was therefore of much interest when I observed on October 29, 1947, in the dry savanna between Paracreek and the airfield "Zanderij," some 45 kilometers south of Paramaribo, an individual which I was able to collect and which is now in my collection. It proved to be a female weighing 73 grams.

By this record the range of this species seems to be extended considerably to the southeast. I must draw attention to the fact, however, that in the large egg collection assembled by the Penard brothers about the beginning of the present century (now in the Leyden Museum) there is an egg attributed to this species from Surinam, though Hellebrekers in his revision of this collection (Zoologische Mededeelingen, 24: 267, 1942), apparently not aware of the existence of any South American forms of this species, calls it *Sturnella m. magna*—FR. HAVERSCHMIDT, *14 Waterkant, Paramaribo, Surinam, Dutch Guiana.*

Grackle competition for dogwood fruit.—An abundant crop of fruit was noted on flowering dogwood trees, *Cornus florida*, near Leesburg, Virginia. Some 20 trees along the Potomac River were much frequented by birds, in particular, the northern flicker, *Colaptes auratus*, the eastern cardinal, *Richmondena cardinalis*, and the tufted titmouse, *Parus bicolor*. About 10:00 a. m. on the morning of October 27 a heavy downpour of rain began. Within 15 minutes large numbers of purple grackles, *Quiscalus quiscula*, accompanied by a few starlings, *Sturnus vulgaris*, began to descend into the dogwoods. These two species had not hithertofore been seen in the dogwood trees.

Both grackles and starlings began to devour ravenously the ripe fruit. Apparently the bill of the purple grackle is not suited for the operation of both plucking fruit and swallowing it. They are able to tear off the fruit with ease but are able to swallow only a small portion of it. The rest is dropped to the ground; many of the grackles were soon at work there. Both the seed and the fleshy part were consumed.

After half an hour the birds suddenly departed. There appeared to have been 800 to 900 grackles and seven or eight starlings in the flock. It was still raining when they left. Later when I inspected the trees, I discovered that they had been completely stripped of fruit. Some uneaten fruit still remained on the ground, particularly near the house, where the birds apparently had been too wary to descend. Without competition, such as I have described, the dogwood trees would have furnished food for many species of birds throughout the fall.—JOHN V. DENNIS, *Moose Hill Bird Sanctuary, Sharon, Massachusetts.*

A new goldfinch from Persia.—During the study of my collections from Iran a new race of the gray-headed form of the goldfinch was discovered.

FEMALE LARK SPARROW AT THE NEST, JUNE 22, 1944, TWO MILES SOUTHEAST OF ATHENS, OHIO.

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Carduelis carduelis ultima, new subspecies

TYPE: Adult male; Niriz, southeastern Fars; March 29, 1940; W. Koelz, collector; deposited in the American Museum of Natural History.

DIAGNOSIS: Differs from all the other races of the gray-headed group of *C. carduelis* by its longer bill. Plumage slightly paler than in *C. c. paropanisi* from Afghanistan and Tian Shan, more grayish, less yellowish on the back, and with somewhat more restricted distribution of gray pigment on the breast and flanks.

MEASUREMENTS OF THE TYPE: Wing, 83.0 mm.; tail, 53.0; bill from skull, 20.0. Five other adult males have the bill: 18.5, 19, 19.5, 20, 20. Average of the six specimens, 19.5.

The bill in *paropanisi* measures: in four males from Tian Shan, 16.5–19.0 (17.62); in 30 males from Afghanistan, 17.0–19.0 (17.65), and in nine from Khorasan, 17.0–19.5 (18.10).

RANGE: Southeastern Zagros Mountains from Niriz south, and the mountains in the region of Kirman, southern Persia.

REMARKS: The type is a breeding bird collected while nesting; the other specimens (five males and three females) were collected in the region of Kirman, from January 30 to February 12. This race is well isolated from all the other races of the gray-headed form by the great deserts of central and southeastern Persia and southern Afghanistan. A little farther northwest in the Zagros, *ultima* is replaced by one of the races (*niediecki*) of the black-headed group. Breeding specimens of this latter race were collected on March 16 at Shiraz. No hybrids were collected.—WALTER KOELZ, *Care of American Consul, Bombay, India.*

A new rose-finch from Afghanistan.—The population of *Carpodacus rhodochlamys* from western Afghanistan in my collection is a new race. It is herewith described as follows:

Carpodacus rhodochlamys bendi, new subspecies

TYPE: Adult male; Burchao Pass, Bend i Turkestan Range, western Afghanistan south of Maimana; October 15, 1939; W. Koelz, collector. Type on deposit in the American Museum of Natural History, New York.

DIAGNOSIS: Very similar to *C. r. grandis* Blyth from western Himalayas (northern Punjab) but slightly paler and with the streaks on the upper surface less conspicuous, a little narrower. Adult female and birds of both sexes in first year plumage slightly paler and with the streaks above and below less conspicuous, a little narrower.

MEASUREMENTS OF THE TYPE: Wing, 93.0 mm.; tail, 73.0; bill from skull, 14.5. Five other adult males have the bill, 14.5–15.5 (15.0 average), and an adult female 15.0 mm. These other adults are just completing the molt, and the wing and tail feathers do not appear to be fully grown.

RANGE: Bend i Turkestan Range (northern side of the Hindu Kush), western Afghanistan. From Terak, about 150 miles east of the Bend i Turkestan Range, it is replaced by *C. r. grandis*.—WALTER KOELZ, *c/o American Consul, Bombay, India.*

Lark sparrow nesting in southeastern Ohio.—Although the lark sparrow, *Chondestes g. grammacus*, is an irregular migrant through Athens County, Ohio, a search of the available records fails to indicate any previous observations of nests or breeding activities of this bird in southeastern Ohio.

On May 24, 1944, in a hilltop pasture five miles northeast of Athens, three lark sparrows (two males and one female) were observed participating in courtship maneuvers. On June 3, Mrs. F. H. Bezdek discovered a lark sparrow nest two miles south-

east of Athens, in an unplowed garden plot less than 50 yards from her house. Vegetation in the immediate region was very sparse, consisting of very short crab grass and scattered horse weeds, *Erigeron canadensis*.

The nest was a well-built cup, two and one-half inches across and one and one-half inches deep, constructed of coarse grasses and lined with rootlets and hair. It was set on the ground, firmly wedged between three horseweed plants which were three to four inches apart and 15 inches high. The nest contained four bluish, speckled eggs. All four eggs hatched June 15 or 16. The accompanying photograph (Pl. 5), as well as a series of movies, was taken on June 22. The young left the nest June 25 at 9:10, 11:15 a. m., 2:30 and 4:30 p. m. The parent birds and the four young remained in or near the garden at least three days.

On July 27, another brood of three young lark sparrows, not over one day out of the nest, was observed being fed by the parent birds on the lawn adjoining the above-mentioned garden. As no other lark sparrows had been found in the vicinity, and as there was sufficient time between broods, it may be reasonably assumed that the same birds were the parents of both broods.

During the summer of 1945, a pair of lark sparrows was again seen several times on this same hill, but no nest was found and no young seen.—H. T. GIER, *Zoology Department, Kansas State College, Manhattan, Kansas (Contribution No. 257)*.

White-winged junco killed by Clark's nutcracker.—The week preceding January 28, 1948, was extremely cold; there were about 12 inches of snow on the ground. Many birds came to feeding trays near my cabin. On January 28 I saw a bird swoop against a window and fall to the porch floor. Before I could retrieve this white-winged junco (*Junco aikeni*), a Clark nutcracker (*Nucifraga columbiana*) darted down and carried the still fluttering junco to a branch of a near by pine tree. There it killed the junco with a few sharp jabs at its head, and then flew away with it. Its behavior was similar to that of a hawk with a mouse.—HELEN D. MACCRACKEN, *P. O. Box 1115, Estes Park, Colorado*.

Pallas's "Reise."—The bibliographical contributions of Elliott Coues do not mention this work and Zimmer's "Catalogue of the Edward E. Ayer Ornithological Library" (II: 480–481, 1926) annotates only the second edition. In Casey Wood's 'Introduction to the Literature of Vertebrate Zoology' (1931: 511), the original publication is listed as of three parts (volumes) 1771–6. That is correct, but it is highly concentrated information. Pallas, or his editors, used the terms "Theil" and "Buch" in a way misleading to the English-trained reader, but entirely justified in German practice. The copy in the Library of Congress includes five separately bound books, and casual handling of them leaves one in doubt as to whether it technically consists of two, three, or five volumes.

Closer examination shows that the most reliable way of dating the parts is by the running heads (not the inconsistent or even missing title pages), and when arranged in chronological sequence, it becomes apparent that there are three volumes, the first with one part, and the second and third with two parts each. These in Pallasian nomenclature, however, are: Theil = volume, and Buch = part.

The general title applicable to all of the work is: P.[eter] S.[imon] Pallas / D. A. D. Professors der Natur-Geschichte [etc., 5 lines] / Reise / durch / verschiedene Provinzen / des / Ruszischen Reichs / . The parts may be cited as:

Erster Theil, St. Petersburg, 1771. 10 + 3–504 pp., numerous pls.

Running heads indicate that the explorations dealt with are those of 1768 and 1769. The / Anhang / Descriptiones fugitiuae animalium atque / plantarum Annis 1768 et

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1769 obseruatorum / (pp. 453–504) contains diagnoses of six species of birds, none of which are as yet known from North America.

Zweyter Theil / Erstes Buch / vom Jahr 1770 / St. Petersburg, 1773, 4 + 3–368 pp., + 6 pp. of errata and improvements, numerous pls.

Running heads agree as to the year involved. There is no "Anhang," but the plates illustrate seven of the new species of birds described in volume 2, part 2, 1773.

Zweyter Theil / Zweytes Buch / vom Jahr 1771 / St. Petersburg, 1773, 371–744 pp., numerous pls.

Running heads agree as to the year involved. "Anhang" (pp. 701–744) includes descriptions of 22 species of birds of which two have subsequently been recorded from North America. *Anas rufina* (p. 713) = *Netta rufina* of the A. O. U. Check-List, 1931 edition. *Charadrius tataricus* (pp. 715–716) = *Eudromias morinellus.*

Dritter Theil / Vom Jahr 1772 und 1773 / St. Petersburg, 1776, 20 + 3–454 pp., numerous pls.

This is part of the third volume; the running heads show that only the year 1772 is dealt with.

Dritten Theils / Zweytes Buch / No title page. [*Upon authority: St. Petersburg, 1776*] *457–760 pp. + 25 pp. (index) + 1 p. (errata), 3 maps but no other pls.*

This "Buch" relates to the years 1773 and 1774. "Anhang" (pp. 691–760) contains descriptions of 32 species of birds, of which seven are also North American.

Motacilla montanella (p. 695) = *Prunella montanella.*

Emberiza rustica (p. 698) = the same.

Charadrius hypomelus (pp. 699–700) = *Squatarola squatarola.*

Charadrius mongolus (p. 700) = the same.

Trynga ruficollis (p. 700) = *Erolia* [*Pisobia*] *ruficollis.*

Anas falcaria (pp. 701–702) = *Anas* [*Eunetta*] *falcata.*

Larus minutus (p. 702) = the same.

Pallas was an all around naturalist, as he described new species of vertebrates, insects, mollusks, and plants from almost the whole range of the plant kingdom. Many of the plants are well illustrated and seven of the new species of birds (none of the North American ones, however) are figured.

His proposals of new species of birds, most of which are still accepted, number 60, and of these nine are included in our Check-List.—W. L. McAtee, *Chicago, Illinois.*

Relation of the desert ironwood tree to nesting.—Over vast areas of the hot Sonoran deserts of Southern California, Arizona, Baja California and Sonora grows the ironwood tree, *Olyneya tesota.* It is especially abundant along the numerous dry and sandy water courses which during summer carry the sheet-flood waters of cloudbursts. Many of the trees are 10 to 30 feet in height and for most of the year have a heavy covering of gray-green foliage. In early summer there is generally an abundance of flowers, followed by a heavy yield of pods containing small, round, flattened seeds. Most of the trees are heavily infested with the leafless desert mistletoe, *Phoradendron californica,* the numerous berries of which yield a source of both food and water to a number of the desert's resident and migratory birds. Among these are the phainopepla, *Phainopepla nitens,* western bluebird, *Sialia mexicana,* and western robin, *Turdus migratorius.* The desert ironwood is not only a leafy tree but also a thorny one, and one would expect that quite a number of desert birds such as shrikes, roadrunners, costa hummingbirds, and gnatcatchers, which ordinarily nest in or about thorny trees and shrubs, would often choose the ironwood trees.

But for some unknown reason such is not the case. I have made, during the past ten years, a special effort to find the nests of birds in *Olneya*, inspecting diligently literally thousands of trees and have been impressed by the almost complete absence of nests. Mr. Wilson G. Hanna who has for years been a persevering collector of birds' nests and eggs, as well as data on birds, has had a similar experience. As do I, he raises the query: Why do so few birds make use of the ironwood as a nesting tree? "No doubt there are exceptions," he once said to me, "but my experience has been that the ironwood is not used when other trees are near by."

Other than those made by the phainopepla which feeds on berries of the mistletoe, I have found in *Olneya* less than a dozen nests. Several of these were very old and may have been those of the mourning dove. Four were those of the verdin, *Auriparus flaviceps*. A verdin's small roosting nest and two large incubating nests I found in a single tree. The other, a roosting nest, was found in a tree near by. All four nests may have been built by the same birds during two successive seasons. I have one record of a nest of a Sonora black-tailed gnatcatcher, *Polioptila melanura*. Mr. Hanna tells me that he has on a number of occasions found the nests of the western red-tailed hawk, *Buteo jamaicensis calurus*, in ironwood.

The phainopeplas which build in *Olneya* trees are probably attracted more by the protection and food provided by the mistletoe than by any special advantages offered by the trees. In other words, the relation is primarily between the birds and the mistletoe, and only secondarily between the birds and the trees.

Several times I have found in long-dead ironwood limbs the excavations of the ladder-backed woodpecker, *Dendrocopos scalaris*, but I could not find evidence that a nest had been built in them, except in one instance. As a general rule, seasoned ironwood is so exceedingly hard to chisel into that small woodpeckers are not attracted to it. This woodpecker occasionally works into the smaller, softer branches to obtain the larva of wood-boring beetles that often infest the inner wood.

Both verdins and gnatcatchers frequently hunt over the small leafy twigs for insects and insect larvae, especially small curculid beetles and leaf-eating larvae of a number of smaller moths.

During the winter season, it is quite a common experience in the daytime to flush long-eared owls, *Asio otus wilsonianus*, from among the top branches. Both in summer and in winter, the larger trees are a favorite roosting place for the gambel's quail, *Lophortyx gambeli*. They offer the birds excellent shelter, both from wind and from avian and mammalian enemies. The quail, like the phainopepla, are often able to flourish in some of our broad waterless desert areas largely because of their habit of eating the berries of the desert mistletoe, in addition to insects and the succulent leaves of several species of *Lycium*.—Edmund C. Jaeger, *Riverside College, Riverside, California.*

"Probability" in subspecific determinations: some comments. — A. L. Rand's paper on subspecific identification (Auk, 65: 416–432, 1948) has so much to recommend it, in setting the stage for discussion, that I trust the following comments will not be considered too amiss.

1. Probability, even to those who are not statisticians, has come to have a mathematical or numerical connotation. A better term is "likelihood" even though this word also is beginning to have numbers attached to it. Perhaps the only non-statistical choice is "sweet reasonableness."

2. It is increasingly clear that little can really be said about variation within a population until we can speak statistically. The mean and extremes of a character

tell us almost nothing. The actual statistical distribution within populations, if known, would enable us to speak of the statistical probability that an individual with a given value for a character belongs to one or another population.

Harrison's case of the mallards (Rand, Auk, 65: 420–421, 1948) offers a chance of estimating the probability of correct identification when several characters agree with those of one race. Six characters are given as separating *Anas p. platyrhynchos* from *conboschas*. If we assume, for the argument, that as regards any one character 25 per cent of birds of *platyrhynchos* ancestry show the *conboschas* form of the character, then $(0.25)^6$ or 0.1 per cent will show five characters agreeing with *conboschas* and $(0.25)^6$ or 0.024 per cent will agree in all six characters. In round numbers these are one bird in 1000 and one bird in 4000. If no selection was involved in gathering the series (not an *a priori* likely supposition), then the chance of the birds described being truly *platyrhynchos* is proportional to the number in the series. Based on the assumption and agreement of six characters the chance is 1 : 1 in a series of 4000 but is 10 : 1 against in a series of 400, using round numbers.

It is, of course, assumed throughout the preceding paragraph that the characters shown by Harrison's British-taken specimens are actually those proper to *conboschas*, rather than facsimiles.

3. The figures for wing-length of the two mallard races (256–278 mm. and 280–295 mm.) may, depending on statistical distribution, be significantly different or not, and the mean length (267 versus 288 mm.) will do no more to determine this significance than will the extremes. At least the standard deviation is needed.

4. If it be contended that color cannot be expressed in numbers, I submit that the contention is unfounded. Not only may gross color be measured with considerable exactness but I venture to predict that the time is not far distant when we will commonly describe the microscopic details of feather color and speak in numbers of the color, size, and distribution of melanin granules and other items in the coloration.

5. On page 420, Rand considers that the probability of taking either *Anas crecca* or *A. carolinensis* in Greenland is even. What is meant is that each species has the same possibility of being taken. Possibility may be regarded as a non-numerical concept in the sense that it has only two values: zero and not-zero. However, if we assume for each species an equal probability of occurrence for the two sexes, then the probability for females may be estimated from the numbers of males of the two species actually taken. From Hörring and Salomonsen I find (omitting the specimens of *crecca* listed on page 9, whose exclusion from other lists is uncertain) that the chance of taking *crecca* vs. *carolinensis* is two and one-half to one in favor of the former (20 male *crecca* against eight of *carolinensis*). Since the ratio of females is 10 : 2, I suspect the cited authors assigned only the indubitable females to the rarer species. The different probabilities of the occurrence of the two species do not, in themselves, affect the probability of a correct identification on purely morphological grounds, but they afford an estimate of the correctness of a series of such identifications.

6. On pages 429 to 430 the question of the status of a breeding wanderer in the range of another subspecies is raised. I venture to submit that it retains the status acquired by birth. That is, the character of an individual depends on its ancestry and not (*pace* the Michurinists) on its current environment. The view that two subspecies cannot share the same habitat applies to populations, not to stray individuals. The view is contradicted by *Parus major* and by certain rodents, although these are exceptional cases.—CHARLES H. BLAKE, *Massachusetts Institute of Technology, Cambridge 39, Massachusetts.*

Papuan dialect names of New Guinea birds.—The following species of birds were collected by the writer in New Guinea during 1944 and 1945. Their names are given in the village language of the Papuans at Dojo or Sowaidewarre on Lake Sentani, Dutch New Guinea. The words were pronounced by a Papuan who was familiar with the different species and transcribed literally in the Malay language by another man who understood the original tongue. In view of the scarcity of vernacular names for New Guinea birds, as expressed by Mayr (1941) in his "List of New Guinea Birds," this note may prove to be helpful as a reference to the common names that are already established in the Lake Sentani region.

Scientific name	*Papuan name*
Cracticus c. cassicus	Manoe
Aplonis m. metallica	Bo
Aplonis cantoroides	Eké
Philemon novaeguineae jobiensis	Kéwa
Pitohui kirhocephalus proteus	Korei
Microdynamis parva grisescens	Wambrore
Centropus phasianinus propinquus	Ibi
Phalacrocorax sulcirostris territori	Manoekaka
Dendrocygna guttata	Wiwi
Rhyticeros plicatus jungei	Debari
Cacatua (Kakatoë) galerita triton	Jeba
Poliolimnas cinereus leucophrys	Kari-kari
Paradisaea apoda novaeguineae	Siaka
Irediparra gallinacea novae-guineae	Neridando

—Harry M. Smith, *Department of Zoology and Physiology, University of Wyoming, Laramie, Wyoming.*

NOTES AND NEWS

The American Ornithologists' Union can no longer furnish free reprints to authors contributing articles to 'The Auk'; greatly increased costs of publication make it impossible. It is hoped that this is only a temporary state of affairs. Authors should order reprints, if desired, on the blanks sent with the galley proof. When ordering, authors should bear in mind that 100 reprints cost no more than do 25.

The Editor is attempting to make more complete the listing of recent ornithological literature in each issue of 'The Auk.' Many journals are searched each quarter, but we undoubtedly miss articles. It would be appreciated if readers of 'The Auk' would send in citations, or preferably reprints, of all papers published by them. This is particularly essential when publication has been outside the United States, in a journal with small circulation, in a journal not devoted exclusively to ornithology, or in a journal not appearing at regular intervals.

Notices have been received of the deaths of Professor Thomas Calder wood Stephens at Sioux City, Iowa, on November 24, 1948, and of Dr. William Coughlin Braislin at New Canaan, Connecticut, on December 3, 1948.

RECENT LITERATURE

The Avian Egg.—Romanoff, Alexis L. and Romanoff, Anastasia J. (John Wiley and Sons, New York), pp. xiii + 918, 424 figures, many tables, January, 1949. Price, $14.00.—One is at once impressed by the detailed information available in this volume. In no other book can be found so much information about the egg before the activation of life within it. This completeness is no doubt due to the 20 years of preparation and the some 15,000 publications (over 2,600 cited) used in the compilation. Much previously unpublished information is also included.

The subject is treated in three parts. Part I deals with morphogenetic expression, including mode of laying, external characteristics, structure, formation, and anomalies. Part II treats the chemical, physical and biological properties of the egg, and part III is on the bio-economic importance of the avian egg, including food value, preservation, and industrial uses.

As an example of the detailed treatment, the chapter on external characteristics takes up: 1) the size of the egg, in relation to variation within the species and to individual, age, seasonal, hereditary and environmental factors; 2) the shape of the egg and its causative factors, in relation to species, breeds of domestic fowl, individual, seasonal, hereditary and physiological differences; 3) color of the egg and 4) shell texture, in relation to these same variable factors; and, 5) mathematical determination of size. All this information is well documented.

The book is clearly and concisely written, and major points are illustrated by graphs, charts, tables, and drawings.

Because of the much greater amount of research on eggs of the economically more important species, the book is understandably slanted toward the members of the Anseriformes and Galliformes. However, those interested in birds other than domestic fowl and game birds will be disappointed that most examples are of domestic fowl, even though studies on other species are available. Species are usually mentioned by the ambiguous common names (grouse, goose, quail and duck).

The bibliography does not include titles of papers. Space requirements may have prevented their inclusion, but in a book covering so many aspects of a subject such a bibliography is difficult to use. The book is indexed in good fashion.

In addition to presenting a wealth of information, the book will provide a definite stimulus for ornithologists to fill in some of the gaps in our knowledge about the eggs of birds.—H. I. Fisher.

Bird Hiking.—Hausman, Leon A. (Rutgers Univ. Press, New Brunswick), pp. 1–104, many text-figures, November 8, 1948. Price, $2.00.—Although this book deals primarily with birds, it is written in nature-lover style and includes rambling accounts of mammals, rocks, fungi and "fox-fire." The feeling of the entire book is perhaps illustrated by the following quotation from page 25, "The bird that summons us forth on an evening ramble is the Nighthawk, whose ornithological name, *Chordeiles minor*, is prettily translated as Little Harp of Evening."

The bulk of the book informs the novice of the mechanics and joys of bird hiking, even to suggesting a suitable breakfast! Here and there are useful bits of information, much diluted, on territory, habitats, altitudinal zonation and seasonal occurrence.

A valuable part of the book is the list of references for nature study, which includes 25 titles on birds and 34 titles on everything from limnology to astronomy.—H. I. Fisher.

Sons of Science.—The story of the Smithsonian Institution and its leaders. Oehser, Paul H. (Henry Schuman, New York), pp. xviii + 220, 39 pls., January

13, 1949. Price, $4.00.—All those interested in the development of science in the United States will enjoy this readable book. Those interested in the study of birds will note that two Secretaries of the Smithsonian, Spencer Fullerton Baird and Alexander Wetmore, have been primarily interested in birds.

The far-flung activities of the Institution are also of importance to ornithologists because they include the extensive collections of birds in the United States National Museum, The National Zoological Park in Washington, D. C. and The Canal Zone Biological Area. The history of these is related briefly.

The story of this century-old institution is told in the form of short biographies of the men who have been responsible for its growth. There is a chronology of principal events in its history and a selected bibliography.—H. I. Fisher.

The flight of birds.—Storer, John H. Cranbrook Institute of Science, Bull. 28, pp. xiv+94, 176 figs., January 5, 1949. Price, $2.50.—Since, and perhaps before, the time of Aristotle, humans have studied and pondered the mechanism of flight by birds. Much of this observation and thought has been of little avail because accurate statements of movements of the wing, or parts of the wing, could not be made. The advent of motion pictures aided greatly, but by far the greatest forward strides in our knowledge of flight have been made by experiments in wind-tunnels and by slow-motion photography.

In this present book, Mr. Storer has presented in clear, understandable terms a brief summary of our knowledge of the mechanics of flight by birds in the light of modern aerodynamics. He begins his discussion with a short introduction on the general principles of aerodynamics, which is well illustrated by diagrams. These facts are then applied to bird flight, including such topics as lift, tilting, stalling angle, drag, turbulence, short versus long wings, wing flaps, feather structure, rudder action of the tail, soaring, gliding and formation-flying. Most of these subjects are illustrated by excellent photographs of wild birds in flight, often in slow-motion sequence, so that movements of the parts of the wing can be studied.

One of the most interesting aspects of the book is the emphasis on the complexity of birds' wings and the varied movements of the various parts of the wing. We often attempt to compare the whole of an avian wing with the whole of a wing of an airplane. Mr. Storer shows the inaccuracy in this by pointing out that at different times the different parts of the wing function in various ways. For example, in flapping flight the proximal part of the bird's wing, as far out as the wrist, functions primarily for lift, as does a plane's wing. The distal portion of the wing functions as a variable pitch propeller to give forward impetus. However, in gliding and soaring, this distal part also serves primarily to increase lift.

The discussion of "slotting" in birds' wings is extensive, giving examples and illustrations of slotting effect and the slots formed by the alula, wing-tips, the wing and tail together, and the covert feathers.

There is a glossary and an index. One might wish the bibliography were more extensive, but the book is recommended reading for every ornithologist.—H. I. Fisher.

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OBITUARIES

WILLIAM THOMAS SHAW, an Associate of the American Ornithologists' Union, died at his home in Fresno, California, May 13, 1948.

Shaw was born of Scotch ancestry in Woodburn, Ontario, February 10, 1873. As an infant he was stricken with infantile paralysis which left his left leg practically useless. Due possibly to this handicap he never married.

Shaw grew up in Minnesota where his early proficiency in preparing specimens helped him work his way through the University of Minnesota, at which he obtained his Bachelor of Agriculture and Bachelor of Science degrees in 1898 and 1899, respectively. His Master of Science degree was received at Michigan State College in 1901, and the degree of Doctor of Philosophy at Stanford University in 1926.

His early teaching positions were at Iowa State College and Oregon State College. He moved to Washington State College, Pullman, Washington, in 1908, where he taught biology, served as curator of the Charles R. Connor Museum, and was zoologist for the Experiment Station connected with the College.

After a year at Stanford he spent a year at Redlands University, filling in for an instructor on leave.

Coming to Fresno State College in 1928, he offered courses where students went on field trips with him and learned much along the trapline, digging out burrows, and

around the campfire. Many students were inspired to follow a career in zoology by participating in his painstaking, patient, and accurate work. Merciless and impatient was he with the student that tried to "get by."

For a time he made yearly trips to Mount Baker in Washington where, in quest of the nest of the Hepburn rosy finch, he camped in the snows of Mount Baker to observe the early phases of the bird's nesting. From this effort came his, "Winter Life and Nesting Studies of the Hepburn Rosy Finch" which appeared in 'The Auk.' With Walter P. Taylor, Stanley Jewett, and J. W. Aldrich, he was working on a "Birds of Washington" which, to the writer's knowledge, he labored to keep up to date in spite of long delays in publishing.

Upon retiring at the age of 70, he maintained an office at the college where he was constantly available to students. His last field trip, on May 8, 1948, was with a few members of the Fresno Natural History Society. He worked at his desk until scarcely an hour before he died.—ALBERT C. HAWBECKER.

JOHN DARLINGTON CARTER, an Associate Member of the American Ornithologists' Union since 1907, died at his home in Lansdowne, Pennsylvania, May 14, 1947. He was born in Chester County, Pennsylvania, on December 30, 1874. Trained at Haverford College and Johns Hopkins University, he followed the profession of chemistry. Leisure time was devoted to ornithology. He learned taxidermy by practice and in the course of his long life installed in the museum at Westtown School specimens of most of the birds, with their nests and eggs, which summer in the middle Atlantic states. He was interred in the Friends' burial ground, Springfield Meeting, near Lansdowne.—A. W. SCHORGER.

CHARLES PELHAM CURTIS, an Associate Member of the American Ornithologists' Union since 1915, died at Ipswich, Massachusetts, on April 26, 1948. He was born in Boston on May 8, 1891. Educated in Paris and Cambridge, he was a prominent lawyer and financier of Boston. He was joint author of a book on hunting in Africa, but his interest in ornithology was patronal.—A. W. SCHORGER.

GEORGE BALCH LAY, an Associate Member of the American Ornithologists' Union since 1939, was born at Concord, New Hampshire, on May 4, 1895. His undergraduate work was done at Yale and the University of North Carolina. In 1932, he received from State College, North Carolina, the degree of Master of Science in entomology. He was attached to the North Carolina Forestry Service prior to spending the years 1935–1946 with the U. S. Biological Survey and Fish and Wildlife Service. In April, 1947, he went to Korea as a civilian employee of the U. S. Army in charge of insect and rodent control. He died there on May 6, 1948. While in North Carolina he was active in various bird clubs. He was buried at Chapel Hill Cemetery, Chapel Hill, North Carolina.—A. W. SCHORGER.

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